United States
Department of
Agriculture

Forest Service

**Intermountain
Research Station**

General Technical
Report INT-232

Western White Pine: An Annotated Bibliography

THE COMPILERS:

RAY J. HOFF is project leader for the Genetics and Pest Resistance of Rocky Mountain Conifers research work unit located at Intermountain Research Station's Forestry Sciences Laboratory, Moscow, ID. He has a B.A. in biology from Western Washington State University and a Ph.D. in botany from Washington State University.

JANET I. QUALLS is editorial assistant for Intermountain Research Station, Ogden, UT.

DALE O. COFFEN is forestry technician for the Genetics and Pest Resistance of Rocky Mountain Conifers research work unit located at Intermountain Research Station's Forestry Sciences Laboratory, Moscow, ID.

CONTENTS

October 1987

Intermountain Research Station
324 25th Street
Ogden, UT 84401

Western White Pine: An Annotated Bibliography

Compilers

Ray J. Hoff
Janet I. Qualls
Dale O. Coffen

INTRODUCTION

This bibliography on western white pine (*Pinus monticola* Dougl.) contains references through 1984. Articles are listed by authors in alphabetical order, and all references have been abstracted. An author index and a subject index are included. The subject index is based on the keywords for each citation. Numbers in the author and subject indexes refer to entries in the bibliography.

The bibliography has been limited largely to articles in English, although a few foreign publications have been included. References include both popular and scientific publications. They also include unpublished theses and typewritten reports. References dealing with white pine blister rust have been omitted unless they provide other data or information.

BIBLIOGRAPHY

1 AUTH Acosta, R. S.
DATE 1962
TITL Resultados obtenidos con plantaciones forestales en la zona montanosa de San Martin de los Andes-Neuquen.
PUBL In: Fifth World Forestry Congress; Seattle, WA; 1960; vol 2, sec 2: 768-772.
ABST The growth of 14 species of trees native to the United States in plantations in the area of San Martin de los Andes in the province of Neuquen is reported. A study of these plantations reveals environmental factor regimes favorable for these species. Also identified are nine adverse factors that hinder forestry in the Patagonia area.
KEYW Plantations, regional environmental factors.

2 AUTH Allen, J. W.
DATE 1959
TITL White pine in western Washington.
PUBL Journal of Forestry. 57: 573-576.
ABST The following figures were given for western white pine in western Washington: annual cut, low 2.8 thousand bd ft in 1949, high 8.7 thousand bd ft in 1941, mean 1940-1956, 6.0 thousand bd ft; total merchantable volume, range 0.1 percent to 4.0 percent, average 0.4 percent (1957 figures); distribution was characterized as scattered throughout area; growth rate, no information available; value, $15 to $30 per thousand bd ft for mature white pine. It was noted that the annual cut was low enough to maintain the species, but that rapid deterioration from blister rust and beetles indicated the need for a major effort to salvage as much volume as possible.
KEYW Annual cut, merchantable volume, distribution, value, western Washington.

3 AUTH Allison, F. E., Murphy, R. M.
DATE 1963
TITL Comparative rates of decomposition in soil of wood and bark particles of several species of pines.
PUBL Soil Science Society of America Proceedings. 63: 309-312.
ABST The finely ground wood and bark of nine species of pine including western white were allowed to decompose in soils in the presence and absence of additional nitrogen for periods of 63 to 800 days. Carbon dioxide evolution was measured at frequent intervals. An average of 16.2 percent of the wood carbon was oxidized in 60 days in the absence of extra nitrogen and 16.9 percent in its presence. Corresponding values for the bark were 8.7 and 8.6 percent. The wood species showed variation in CO_2 evolution during the 60-day period, ranging from 8 percent for sugar pine to 51 percent for shortleaf pine. The variation for the bark was between 3.0 percent for white pine and 23.3 percent for lodgepole pine. Most of the pine wood decomposed somewhat more rapidly than did the other softwoods previously studied, but not nearly so rapidly as did the hardwoods. Pine barks are oxidized at about the same slow rate as other softwood barks.
KEYW Decomposition, soils, wood particles, bark particles.

4 AUTH Amerson, H. V., Mott, R. L.
DATE 1982
TITL Improved rooting of western white pine shoots from tissue cultures.

PUBL Forest Science. 38(4): 822-825.
ABST Rooting of adventitious shoots of western white pine continuously exposed to a variety of growth regulators for 6 weeks varied between 0 and 20 percent. Pulse treatment of similar shoots for 7 days with the same growth regulator treatments followed by 5-week culture on medium devoid of growth regulators provided 40 to 64 percent rooting. In paired comparisons, pulse treatments always provided better rooting percentages than did constant exposure treatments. Improved root growth and the initiation of multiple roots were also favored by pulse treatments.
KEYW Tissue cultures, root initiation and growth.

5 AUTH Amman, G. D.
DATE 1982
TITL Characteristics of mountain pine beetles reared in four pine hosts.
PUBL Environmental Entomologist. 11(3): 590-593.
ABST Mountain pine beetles obtained from naturally infested lodgepole pine were reared in four common hosts: ponderosa pine, western white pine, whitebark pine, and lodgepole pine. Emerging beetles were collected daily, counted and sexed, and pronotal width was measured. Significant differences in brood production, size of female beetles, and developmental rate, but not sex ratio, occurred among hosts. Differences were not all associated with the same species of tree. However, the results indicate that, overall, lodgepole pine is the poorest and ponderosa pine is the best of the four hosts for mountain pine beetle.
KEYW Mountain pine beetle.

6 AUTH Anderson, A. B.
DATE 1944
TITL Chemistry of western pines.
PUBL Industrial and Engineering Chemistry. 36: 662-663.
ABST This article deals with the possible recovery and utilization of chemical products from three western pines. The newer methods of wood analysis, which were developed on other woods, are applicable to these important commercial woods. The extractives are not an integral part of the lumber, and because the pines are rich in this wood fraction, they offer an opportunity for economic recovery.
KEYW Wood analysis, extractives, economic recovery.

7 AUTH Anderson, A. B.
DATE 1950
TITL Chemistry of western white pines.
PUBL Industrial and Engineering Chemistry. 42(3): 565-569.
ABST This paper deals with the isolation and preliminary examination of the chemical nature of the extractives present in pine knots from three commercially important western pines—ponderosa, Idaho white, and sugar. Experimental evidence is offered for the first time, indicating which components in knot extract are largely responsible for paint discoloration over knots. The information was helpful in arriving at a knot-sealer formulation that has proved beneficial in alleviating this paint problem.
KEYW Knot extract, paint discoloration, knot sealer.

8 AUTH Anderson, A. B., Riffer, R. B., Wong, A.
DATE 1969
TITL Monoterpenes, fatty and resin acids of *Pinus lambertiana* and *Pinus monticola*.
PUBL Phytochemistry. 8: 869-872.
ABST The sapwood and heartwood of sugar pine and western white pine have been examined for monoterpenes and fatty and resin acids. The principal qualitative differences between the terpene compositions are the presence of delta (super 3)-carene in significant amounts in sugar pine and its apparent absence in western white pine, and the presence of n-decane in western white pine and its absence in sugar pine. The seldom-reported trans-cinnamic acid was found in each of these pines, but the recently reported sugar pine resin acid, lambertianic, was not found in western white pine.
KEYW Monoterpenes, fatty acids, resin acids.

9 AUTH Anderson, H. W., Wilson, B. C.
DATE 1966
TITL Improved stratification procedures for western white pine seed.
PUBL [Olympia, WA]: State of Washington, Department of Natural Resources; Report 8. 11 p.
ABST Two lots of coastal Washington western white pine seed were subjected to various combinations of warm (approximately 24 °C) and cold (2-5 °C) stratification and incubated for 30 days at 25 °C without light. Results were analyzed by analysis of variance. Warm stratification increased germination from 15.1 percent at no stratification to 33.2 percent at 30 days stratification. Cold stratification generally increased germination with increased length of stratification. The combination of 30 days cold stratification preceded by 30 days warm stratification significantly increased germination over all other treatments and almost doubled germination (56.8 percent versus 31.5 percent) when compared to the

recommended 90-day cold stratification period.
KEYW Seed stratification.

10 AUTH Anderson, I. V.
DATE 1930
TITL Log damage on gravity chutes: an analysis of volume and value loss of Idaho white pine logs.
PUBL The Timberman. 30(3): 1-4.
ABST The shorter logs in this study not only suffered the greatest value loss, but also lost the greatest volume per thousand feet of logs handled. Loss in lumber-selling value for this run (8.1 per thousand) of logs was $1.37 per thousand, but increased to $2.37 for logs running 14 logs per thousand. This represents the maximum loss to be expected where the average effort is made to check the logs and the usual trimming allowance of 6 to 8 inches is used. The volume-loss log scale from chute defects in this study can be considered as 4 percent for timber running eight and nine logs to the thousand, 5 percent for 10-, 11-, and 12-log timber, and 6 percent for 13- and 14-log timber. These figures are only applicable to steep chute chances where the average precautions are taken to reduce log damage. A maximum trimming allowance of 10 inches is necessary to avoid excessive brooming and splitting loss on all chutes too steep for trailing. Well-constructed and properly located "bear traps" will no doubt eliminate this loss and, where they work, are more desirable than using the extra trimming allowance. Slabbing defect is not serious unless the "goose necks" are set to whirl the logs, thereby scoring the entire outside perimeter of the log.
KEYW Log damage.

11 AUTH Anderson, I. V.
DATE 1932
TITL Breakage in felling study: western white pine type.
PUBL Unpublished report. On file at : U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID. 3 p.
ABST The tables and explanatory notes in this memorandum have been prepared only as an office record for the breakage study of the western white pine type. Compilations are given for variations in direction of felling and slope; frozen and unfrozen timber felled on bare ground and in different depths of snow; by causes (windfall, log, stump, rock, and miscellaneous); by character of ground; by number of lots per tree classes; and by age class segregation.
KEYW Felling breakage.

12 AUTH Anderson, I. V.
DATE 1932
TITL Office memoranda on methods of procedure and results of the Ohio Match Company project.
PUBL Unpublished report. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID. 44 p.
ABST These memoranda describe in detail the procedures used in conducting a study of an Ohio Match Company gyppo logging project. Data includes description of the area, logging methods, objectives and techniques, early results of the study, and the reason for termination. They also include a comparison of logging and milling costs to lumber selling values by tree sizes, stand tables of the area, and stand and volume data.
KEYW Gyppo logging, logging.

13 AUTH Anderson, I. V.
DATE 1934
TITL Breakage losses and cull percent of timber in the Inland Empire.
PUBL Applied Forest Note 63. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Cull percentage for western white pine averaged 15 percent, ranging from 3 percent in trees 80 to 100 years old to 24 percent in trees over 300 years old.
KEYW Breakage loss, cull percentage.

14 AUTH Anderson, I. V.
DATE 1935
TITL Match plank and commercial lumber from western white pine logs.
PUBL Applied Forestry Note 72. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Out of the 356 million feet of western white pine produced in 1934 in the Inland Empire, a total of 101 million feet was match plank. This constituted 28 percent of the total cut.
KEYW Matches, lumber, match plank.

15 AUTH Anderson, I. V.
DATE 1939
TITL Review of "Results and application of a logging and milling study in western white pine of northern Idaho," by E. F. Rapraeger.
PUBL Journal of Forestry. 37: 505.
ABST Anderson concludes, "The bulletin is well worth careful study by students and practicing foresters interested in the economics of logging and milling."
KEYW Logging, milling, economics.

16 AUTH Anderson, I. V.
DATE 1948
TITL Specifications for knotty western white pine veneer flitches.
PUBL Research Note 68. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 1 p.
ABST Specifications are given for knotty western white pine flitches. Logs yielding satisfactory slicing flitches are usually from the limby portion of the tree where knots are small, sound, and properly spaced. Logs cutting a high proportion of No. 2 common lumber give highest flitch yields.
KEYW Knotty flitches.

17 AUTH Anderson, I. V.
DATE 1954
TITL Suitability of Rocky Mountain woods for veneer and plywood.
PUBL Journal of Forestry. 52(8): 587-591.
ABST Current and future trends in utilization of Rocky Mountain tree species for veneer and plywood production are discussed. The highest potential for commercial expansion is foreseen to be in the field of knotty paneling.
KEYW Veneer, plywood, knotty paneling.

18 AUTH Andresen, J. W.
DATE 1966
TITL A multivariate analysis of the *Pinus chiapensis-monticola-strobus* phylad.
PUBL Rhodora. 68(773): 1-24.
ABST Provides a statistical basis for a determination of the proper taxonomic disposition of this controversial taxon. A companion paper (Andreson 1964) recommends that *P. strobus* var. *chiapensis* be elevated from varietal to specific rank. This proposal was predicated on evidence from this study of morphologic and progeny data.
KEYW Taxonomy, multivariate analysis, coefficient of divergence, leaf characters, seedling characteristics.

19 AUTH Andrews, D. S.
DATE 1980
TITL Rooting western white pine, *Pinus monticola* Dougl., needle fascicles and branch cuttings.
PUBL Research Note INT-291. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 11 p.
ABST Three experiments were conducted to investigate effects of IBA, kinetin, GA3, b-nine, sucrose, and of an acid and a base on the rooting of western white pine needle fascicles and branch cuttings. IBA, b-nine, sucrose, and acid were all effective in enhancing root initiation.
KEYW Vegetative propagation, rooting, rooting needle fascicles.

20 AUTH Arkwright, P.
DATE 1967
TITL Canadian white pines.
PUBL Woodwork Industry. 24: 37.
ABST Western white pine is used for much the same purposes as the eastern variety. It is a slightly heavier species, averaging 26 lb to the cubic foot air dry, but it is not suited for purposes where strength is of importance. The two varieties are very similar in general appearance, though the western white pine is normally rather darker in color in the heartwood and has a more noticeable growth ring figure. Although durability standards are (for a softwood) good without being really exceptional, western white pine is generally regarded as being less durable than the eastern variety.
KEYW Physical properties, uses.

21 AUTH Arno, S. F., Pfister, R. D.
DATE 1977
TITL Habitat types: an improved system for classifying Montana's forests.
PUBL Western Wildlands. 3: 6-11.
ABST The habitat types of Montana are described. Potential yield, watershed, recreation, and forest protection aspects are discussed.
KEYW Habitat types.

22 AUTH Arnold, D. L.
DATE 1948
TITL Growing space ratio as related to form and development of western white pine.
PUBL Moscow, ID: University of Idaho. 48 p. M.S. thesis.
ABST To gain an understanding of growing space relationships in normal stands of western white pine, average stand diameter and crown spread (spacing) for various ages and site qualities were calculated from normal yield tables. In normal stands of western white pine the growing space ratio was approximately the same for all sites at any given age, but the ratios for poor sites were much lower when stands were compared on the basis of average stand diameter. Statistical analysis of the relation between d.b.h. and crown spread showed a high correlation between these measurements.
KEYW Form, development, growing space ratio, growth rate, annual increment, crown area index.

23 AUTH Axelrod, D. I.
DATE 1956
TITL Mio-pliocene floras from west-central Nevada.
PUBL Geology Science 33. Berkeley, CA: University of California. 322 p.
ABST This manuscript includes a brief discourse relating *Pinus wheeleri* to such living white pines as *P. monticola* and *P. strobus*. The occurrence of a pine related to *P. monticola* in the Nevada flora, at no great distance from woodland and chaparral vegetation, scarcely agrees with the ecologic occurrence of its living analog.
KEYW *Pinus wheeleri*, fossil flora.

24 AUTH Bagnell, C. R.
DATE 1975
TITL Species distinction among pollen grains of *Abies, Picea*, and *Pinus* in the Rocky Mountain area (a scanning electron microscope study).
PUBL Review of Palaeobotany and Palynology. 19: 203-220.
ABST Modern pollen grains from several species of *Abies, Picea,* and *Pinus* occurring mainly in the Rocky Mountain region of the United States and Canada were examined using the scanning electron microscope. Distinguishing characteristics for the species were found using systematized observational and photographic methods on extensive collections. Preparation of the samples included acetolysis, critical-point drying to preserve three-dimensional morphology, and carbon-gold coating. The technique employed in preparing the pollen samples is outlined in detail in this paper. Species distinctions were based on types of morphological structures rather than on measurements of the grains or their parts; however, several subjective determinations of shape and proportion proved useful in distinguishing certain species. *Pinus ponderosa* differs from *P. contorta* on the basis of cappula morphology. *Pinus monticola* and *P. albicaulis* can be singled out from the other pines studied and distinguished one from the other by a combination of cappula and cappa characteristics. *Pinus cembroides* is distinguished from the other pines by its characteristic cappa and *P. edulis* by shape, proportion, and attachment of its bladders. Although *P. monophylla* showed no single distinctive morphological feature, it can be separated from the other pines studied by a process of elimination based on several characteristics.
KEYW Pollen morphology.

25 AUTH Bailey, W. H.
DATE 1964
TITL Revegetation in the 1914-1915 devastated area of Lassen Volcanic National Park.
PUBL Corvallis, OR: Oregon State University. Ph.D. dissertation. Dissertation Abstracts 24: 3068.
ABST Western white pine was one of the early pioneers to become established.
KEYW Revegetation of volcanic area, Lassen Peak revegetation.

26 AUTH Baker, F. S.
DATE 1949
TITL A revised tolerance table.
PUBL Journal of Forestry. 47: 179-181.
ABST In this revision of Zon and Graves' (1911) tolerance table for important U.S. trees, western white pine is ranked as first under intolerant western conifers, or (more acceptable to those responding to questionnaire) as first under intermediate.
KEYW Tolerance.

27 AUTH Barnes, B. V.
DATE 1964
TITL Self- and cross-pollination of western white pine: a comparison of height growth of progeny.
PUBL Research Note INT-22. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST Height growth of 9- to 12-year-old western white pine seedlings from self-pollinated parents was compared with that of seedlings from cross- pollinated parents. Data indicate that growth depression from selfing, previously observed in the nursery, continues undiminished after inbred seedlings are outplanted.
KEYW Self pollination, cross pollination, height growth.

28 AUTH Barnes, B. V.
DATE 1967
TITL Phenotypic variation associated with elevation in western white pine.
PUBL Forest Science. 13: 357-364.
ABST Racial differentiation of *Pinus monticola* associated with elevation was investigated on sample plots selected at elevations ranging from 2,500 to 4,600 feet. Periodic annual height growth was significantly less for trees at 4,600 feet than for trees at elevations ranging from 2,500 to 4,000 feet. Branch angle increased progressively and significantly with increasing elevation. Needle length and cone scale width and length between elevations differed significantly, but the pattern of variation was essentially random. For other attributes, including seed weight, no significant difference was found

between elevations. There were highly significant and moderately strong correlations between many cone and seed traits. In general, cone and seed traits were not significantly correlated with growth rate or branch angle.

KEYW Phenotypic variation, growth rate, branch angle, needle length, cone variation patterns, seed weight.

29 AUTH Barnes, B. V.
DATE 1969
TITL Effects of thinning and fertilizing on production of western white pine seed.
PUBL Research Paper INT-58. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 14 p.
ABST In a 40-year-old western white pine plantation developed as a seed production area, heavy thinning and application of fertilizer in the fall significantly increased strobilus production the following spring. Applying fertilizer increased seed weight and cone length significantly, but thinning did not. Insects severely damaged the cone crop in the thinned stand. This study indicates that abundant seed crops, relatively free from insect damage, may be produced without expensive thinning and area preparation operations.
KEYW Genetic gain, seed production areas, strobilus production, fertilization, seed production rates.

30 AUTH Barnes, B. V., Bingham, R. T.
DATE 1962
TITL Juvenile performance of hybrids between western and eastern white pine.
PUBL Research Note 104. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 7 p.
ABST The growth and performance of *Pinus monticola, P. strobus*, and their hybrids were investigated at several sites in northern Idaho and western Montana. At three sites in northern Idaho, two hybrid progenies were approximately twice as tall and markedly excelled corresponding *P. monticola* progenies (having the same female parents) in height growth at age 8 years. At one site in western Montana none of the few *P. monticola, P. strobus*, and hybrid progenies performed satisfactorily. All except a high-elevation *P. monticola* source from California were severely damaged by snow.
KEYW Hybrids, *Pinus monticola* x *P. strobus*.

31 AUTH Barnes, B. V., Bingham, R. T.
DATE 1963
TITL Cultural treatments stimulate growth of western white pine seedlings.
PUBL Research Note INT-3. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST An experiment was conducted to determine the effectiveness of cultural treatments (cultivating, fertilizing, and watering in all possible combinations) in stimulating growth rate and inducing strobilus formation in western white pine seedlings in northern Idaho. Although strobilus production was negligible, striking differences in total height and diameter at 12 inches above the ground were attributed to the cultural treatments. The combined three-factor treatment was most effective in stimulating height and diameter growth. Cultivation was the most effective single treatment and the most effective component of double treatments, particularly in stimulating diameter growth. The use of these cultural treatments is a promising method of developing seed orchard trees of sufficient size and vigor to bear large cone crops.
KEYW Cultural treatments, cultivation, watering, fertilization.

32 AUTH Barnes, B. V., Bingham, R. T.
DATE 1963
TITL Flower induction and stimulation in western white pine.
PUBL Research Paper INT-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 10 p.
ABST Several methods of inducing and stimulating strobilus production were tested. These included: (1) top grafting 5-year-old seedling scions, (2) top grafting 6-year-old seedling scions, (3) cultivating, watering, and fertilizing young (average age 11 years) trees, (4) stimulation by fertilization in fruiting age (average 28 years) trees. None of the attempts were successful.
KEYW Flower induction, flower stimulation, top grafting, cultivation, irrigation, fertilization, strobilus production stimulation.

33 AUTH Barnes, B. V., Bingham, R. T., Schenk, J. A.
DATE 1962
TITL Insect-caused loss to western white pine cones.
PUBL Research Note 102. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 7 p.

ABST Insects of three genera, *Conophthorus*, *Dioryctria*, and *Eucosma*, have caused severe loss to cone crops of western white pine in two areas in northern Idaho. The western white pine cone beetle, *Conophthorus monticolae,* destroyed more than 90 percent of the cones on 12 trees from one area during a 6-year period. At a second locality, larvae of *Dioryctria abietella* and *Eucosma rescissoriana* infested 19 percent of the cones on 54 trees in a relatively good seed year and 78 percent in the following, but relatively poor, seed year. Losses varied seasonally.

KEYW Cone insects, *Conophthorus monticolae*, *Dioryctria abietella*, *Eucosma rescissoriana.*

34 AUTH Barnes, B. V., Bingham, R. T., Squillace, A. E.
DATE 1962
TITL Selective fertilization in *Pinus monticola* Dougl. II. Results of additional tests.
PUBL Silvae Genetica. 11: 103-111.
ABST Eight tests involving four female parents and six male parents were made to determine the extent of reproductive discrimination between competing self- and outcross-pollens of western white pine trees. Two seed trees were termed "partially self-fertile." In one completely self-fertile tree selfing exceeded outcrossing when competing pollens were in the ratio 1:1. In the second completely self-fertile tree, selfing predominated when self-pollen was in competition with pollen of one tree (ratio 1:1), but outcrossing exceeded selfing when self-pollen was in competition with the pollen mix. In the two partially self-fertile trees, when outcross and self-pollens were competing in the ratio 1:1, outcross pollen was more effective in yielding germinable seed than self-pollen in practically every test. Albino seedlings in the ratio one white to three green were found to occur in the selfed progeny of partially self-fertile tree 64. A positive correlation between parent tree growth rate and pollen-tube vigor was advanced. Findings could be explained by this relationship in nearly every instance.
KEYW Selective fertilization, seed yield, inbreeding, controlled pollination, self fertility.

35 AUTH Barrett, L. I., Briegleb, P. A., Mark, G. C., Roe, A. L.
DATE 1958
TITL Appendix: criteria for rating productivity.
PUBL In: Timber resources for America's future. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 691-700.
ABST Classifies species according to forest type group. Lists trees per acre, seed source classification, seedbed conditions, percentage of mean annual growth, effective seeding distance.
KEYW Timber classification, mean annual growth, seeding distance.

36 AUTH Base, S. R., Fosberg, M. A.
DATE 1971
TITL Soil-woodland correlation in northern Idaho.
PUBL Northwest Science. 45(1): 1-6.
ABST Site index prediction equations were developed for *Pinus monticola, P. contorta, P. ponderosa*, and *Larix occidentalis* using regression analysis techniques. Correlations were made between soils of unknown productivity and similar soils of known productive capacities. The equation for western white pine is fairly reliable; those for the other three species are less reliable.
KEYW Soil-woodland correlation, site quality.

37 AUTH Bates, C. G.
DATE 1925
TITL The relative light requirements of some coniferous seedlings.
PUBL Journal of Forestry. 23: 869-879.
ABST The minimum light requirement for western white pine seedlings as shown by survival at the end of an 11-month period is listed as 97 percent of full sunlight. Seed weight has a possible influence on ability to survive in weak light.
KEYW Light requirements, seed weight.

38 AUTH Behre, C. E.
DATE 1924
TITL Prediction of yields of young western white pine timber in Idaho.
PUBL Idaho Forester. 6: 32-36.
ABST Yield predictions for a young stand of predominantly western white pine near Clarkia, ID, are given. The predictions were based on a systematic sample of d.b.h. and increment cores. Yield tables for white pine and for white pine-larch mixtures are given.
KEYW Yield prediction, regeneration, reproduction, growth prediction.

39 AUTH Behre, C. E.
DATE 1945
TITL Growing stock, cutting age, and sustained yield.
PUBL Journal of Forestry. 43: 477-485.
ABST Better understanding of the Nation's forest situation requires an appraisal of present stand in relation to the volume of growing stock needed to sustain prospective timber requirements. For a given level of output the required growing stock is a function of cutting age and may be expressed as a multiple of the yield. Growing-stock ratios,

deduced from available yield tables and assumptions as to average cutting ages, indicate that the poorly distributed volume of timber we now have (1945) is not greater than the well-distributed volume of growing stock we shall need in order to maintain the current level of output, to say nothing of attaining a larger potential yield.

KEYW Growing stock, cutting ages, sustained and potential timber requirements.

40 AUTH Bendtsen, B. A.
DATE 1973
TITL Important structural properties of four western softwoods: white pine, sugar pine, western redcedar, and Port Orford cedar.
PUBL Research Paper FPL-191. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 17 p.
ABST The most comprehensive evaluation ever conducted on these four species has provided new values for the important mechanical properties and specific gravity. No species showed a consistent increase or decrease in all properties at either green or air dry moisture condition. However, in each species, at least two important green property values that are the basis for development of structural design properties were changed significantly. Five out of six such property values of white pine changed significantly.
KEYW Wood values, structural properties.

41 AUTH Benea, V., Leandru, L., Nitu, C.
DATE 1964
TITL Physiological and biochemical studies in pine breeding.
PUBL In: Proceedings, FAO World Consultation on Forest Genetics; 1983; Stockholm, Sweden. p. 11-18
ABST A series of physiological and biochemical studies were carried out to determine: respiration intensity, total phosphorus and nitrogen content, amino acids, and carbohydrates. Comparisons were made of species and hybrids.
KEYW *Pinus monticola* x *P. strobus,* species crosses, respiration intensity, phosphorus content, nitrogen content, amino acids, carbohydrates, hybrids.

42 AUTH Benson, R. E., Kirkwold, L. L.
DATE 1967
TITL Market trends for western white pine.
PUBL Research Note INT-65. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST Western white pine has historically been one of the most important timber species harvested in the Rocky Mountain area. This study summarizes changes that have taken place during the past 4 decades in western white pine lumber production, lumber prices, and major manufacturing uses.
KEYW Lumber production, manufacturing, lumber prices, market trends.

43 AUTH Betts, H. S.
DATE 1940
TITL Western white pine (*Pinus monticola*).
PUBL American Woods. Washington, DC: U.S. Department of Agriculture, Forest Service. 8 p.
ABST This paper, from the "American Woods" series, gives a general description of western white pine. (See revision dated 1954.)
KEYW Description, range, uses, production.

44 AUTH Betts, H. S.
DATE 1954
TITL Western white pine.
PUBL American Woods. Washington, DC: U.S. Department of Agriculture, Forest Service. 6 p.
ABST This paper, from the "American Woods" series, gives a general description of western white pine, including nomenclature, distribution and growth, production, properties, and principal uses.
KEYW Range, products, production, uses, description.

45 AUTH Biddle, P. G., Tinsley, T. W.
DATE 1968
TITL Virus diseases of conifers in Great Britain.
PUBL Nature. 219: 1387-1388.
ABST Virus-like particles were obtained from sap exudates of 4-year-old seedlings showing a severe stem necrosis resulting in defoliation and death of the shoot. Defoliation is a symptom of the virus infection.
KEYW Virus disease, Great Britain, seedling mortality.

46 AUTH Billings, C. L.
DATE 1924
TITL Slash disposal in a privately owned white pine stand.
PUBL Idaho Forester. 6: 23-25.
ABST Reports on an experiment implementing piling and burning for slash disposal on a privately owned white pine stand.
KEYW Slash disposal, fire danger, broadcast burning.

47 AUTH Billings, R. F., Gara, R. I.
DATE 1975
TITL Rhythmic emergence of *Dendroctonus ponderosae* (Coleoptera: Scolytidae) from two host species.

PUBL Annals Entomological Society of America. 68: 1033-1036.

ABST Emergence of adult *Dendroctonus ponderosae* Hopkins from ponderosa pine and western white pine exhibited distinct host-specific patterns under field conditions that appeared closely correlated with ambient temperatures in the latter host species but not in the former. The lower temperature threshold for beetle emergence was ca. 16 °C. Periodicities in emergence from both host species also prevailed under conditions of constant temperature and light, providing evidence of an endogenous rhythm. Ratios of one male to three females, observed during the first week of seasonal emergence from ponderosa pine, appeared to change in favor of males as the season progressed. A more constant 1:2 male to female ratio was maintained to broods emerging from western white pine.

KEYW *Dendroctonus ponderosae*, emergence bark beetles.

48 AUTH Bingham, R. T.

DATE 1972

TITL Station publications in forest genetics and related fields.

PUBL Research Note INT-157. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 10 p.

ABST Lists 123 Station and Station-connected publications in forest genetics, tree breeding, and related fields, dating from 1921. Revises and updates Roberts, V., USDA Forest Service Res. Note INT-48, 1966. Over one-half of the publications are concerned with white pines (principally *Pinus monticola*), and over one-third deal with various aspects of white pine blister rust resistance.

KEYW Genetics, breeding, bibliography.

49 AUTH Bingham, R. T.

DATE 1973

TITL Possibilities for improvement of western white pine by inbreeding.

PUBL Research Paper INT-144. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 18 p.

ABST *Pinus monticola* seedling mortality, timing and extent of fruiting, strobilus attrition, crossing success, seed yield, and seed weight are compared for 18 selfed lines and their outcrossed half-sib lines. No reproduction barriers are restrictive enough to preclude continued inbreeding. Filled seed yields from second generation inbreeding were low but consistent and large enough to justify continuing an experimental program. Results of experimental single crossing between S_1 lines should guide decision on a practical inbreeding program.

KEYW Pedigree, seed germination, inbreeding.

50 AUTH Bingham, R. T., Hanover, J. W., Hartman, H. J., Larson, Q. W.

DATE 1963

TITL Western white pine experimental seed orchard established.

PUBL Journal of Forestry. 61: 300-301.

ABST Seed orchard management practices for increasing efficiency in mass-production of genetically improved western white pines are under investigation in a new experimental orchard at Sandpoint, ID. Information gained there may soon find application in the operation of nearly 100 acres of grafted seed orchards proposed for practical production of blister rust resistant F_2 seed.

KEYW Seed orchards.

51 AUTH Bingham, R. T., Hoff, R. J., Steinhoff, R. J.

DATE 1972

TITL Genetics of western white pine.

PUBL Research Paper WO-12. Washington, DC: U.S. Department of Agriculture, Forest Service. 28 p.

ABST Summarizes the results of 20 years' research on the genetics of *Pinus monticola*, with particular reference to its palaeo-botany, present botanical range, habitat, growth, floral biology, cone- and seed-yielding ability, self-pollination and selective fertilization, capacity for reproduction by rooting and grafting taxonomy, crossability, hybridization with other species, monoterpene composition, and resistance to insects and diseases. Emphasis is placed on resistance to *Cronartium ribicola* and on the improvement of this trait.

KEYW Genetics, breeding, reproductive behavior, variation, vegetative propagation, chemical constituents, disease survey, stem rusts.

52 AUTH Bingham, R. T., Rehfeldt, G. E.

DATE 1970

TITL Cone and seed yields in young western white pines.

PUBL Research Paper INT-79. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 12 p.

ABST Eighteen years of cone and seed yields from 179, 30- to 50-year-old western white pine representative of 13 geographic localities were compared. Each tree averaged 28 cones per tree, and each cone contained about 104 filled seeds.

KEYW Seed production, cone production.

53 AUTH Bingham, R. T., Squillace, A. E.
DATE 1955
TITL Self-compatibility and effects of self-fertility in western white pine.
PUBL Forest Science. 1: 121-129.
ABST Cone and seed yields and seed germinability following self-pollinations in western white pine were compared with corresponding yields and germinability following cross-pollinations on the same trees. Self-pollinated seedling heights the first, second, and third years were 11, 21, and 21 percent below cross-pollination heights, respectively. Some natural barriers to selfing are not completely effective.
KEYW Self compatibility, selfing barriers.

54 AUTH Bingham, R. T., Squillace, A. E.
DATE 1957
TITL Phenology and other features of the flowering of pines, with special reference to *Pinus monticola* Dougl.
PUBL Research Paper INT-53. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 26 p.
ABST Flowering in 45 young *Pinus monticola* trees was closely observed for up to 6 years. Results were: (1) average dates of first anthesis at low and high elevations were June 27 and July 8, respectively; (2) period of pollen dissemination averaged 8-1/2 days: period of ovulate flower receptivity 9-1/2 days; (3) very fruitful individuals had prolonged flowering periods; (4) flowering was delayed about 5 days per 1,000-ft increase in elevation and about 6 days per °F departure of May and June temperatures below normal.
KEYW Flowering, anthesis, pollen dissemination, self pollination, crossing, phenology flowering.

55 AUTH Bingham, R. T., Squillace, A. E., Duffield, J. W.
DATE 1953
TITL Breeding blister-rust-resistant western white pine.
PUBL Journal of Forestry. 51: 163-168.
ABST Summarizes work on development of blister rust resistant western white pine including methods of vegetative propagation.
KEYW Disease resistance, selection, vegetative propagation, intraspecies breeding, grafting.

56 AUTH Bingham, R. T., Squillace, A. E., Patton, R. F.
DATE 1956
TITL Vigor, disease resistance, and field performance in juvenile progenies of the hybrid *Pinus monticola* Dougl. x *Pinus strobus* L.
PUBL Silvae Genetica. 5(4): 104-112.
ABST Juvenile performance of 16 different hybrid progenies from controlled pollinations between *Cronartium ribicola*-resistant selections of *P. monticola* and *P. strobus* is discussed. The progeny exhibited significantly different average height growth rates. Preliminary evaluations indicate that hybrid resistance may be lower than in corresponding intraspecies progenies. Acclimatization of the hybrids remains conjectural.
KEYW Hybrids, hybrid growth.

57 AUTH Bingham, R. T., Wise, K. C.
DATE 1968
TITL Western white pine cones pollinated with 1- to 3-year-old pollens give good seed yields.
PUBL Research Note INT-81. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST Filled seed yields of *Pinus monticola* cones from 55 controlled crosses made with 1- to 5–year-old, deep-freeze-stored pollens were compared with yields from other fresh-pollen crosses made on the same trees in the same pollination seasons. Observations covered four pollination seasons, and on the average involved about 11 trees, and 14 stored-pollen and 25 fresh-pollen crosses thereon, per season. One- to 3-year-old pollens gave 52 to 110 percent of the yield observed for fresh pollens, and there was some evidence that 4- and 5-year-old pollens might also be satisfactory for routine use.
KEYW Pollination, pollen storage.

58 AUTH Bingham, R. T., Wise, K. C., Wells, S. P.
DATE 1969
TITL Aberrant cones in western white pine.
PUBL Research Note INT-86. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Two rare cone forms—proliferated and forked—are reported and illustrated for *Pinus monticola*. The latter form may be unique to this species and may be genetically controlled. In addition, genes controlling the forked-cone trait may be linked with recessive genes associated with chlorophyll deficiencies of *P. monticola* foliage.
KEYW Aberrant cones, chlorophyll deficient.

59 AUTH Blair, J. H.
DATE 1946
TITL Frost damage to woodlands on Blairquhan Estate in April 1945.
PUBL Scottish Forest Journal. 60(1): 38-43.
ABST Frost damage occurring April 29, 1945, is summarized for the Blairquhan Estate

conifer hardwood plantations. A discussion follows outlining steps that may prevent future losses.

KEYW Frost damage, genetic selection, natural regeneration.

60 AUTH Blanchette, R. A.
DATE 1979
TITL Cell wall decomposition by *Phellinus (Fomes) pini.*
PUBL Phytopathology. 69(8): 913.
ABST Wood decomposition by *Phellinus (Fomes) pini* in living white pine was investigated using scanning electron microscopy. Preferential loss of lignin resulted in a unique type of cell wall degradation. Macrofibrillar bundles (0.2 to 0.4 mm) remained within the tracheid wall while noncellulosic wall materials were removed. Degradation occurred at appreciable distances from fungal hyphae indicating that a highly diffusable lignin degrading enzyme system is involved. Ray parenchyma cells were completely destroyed. The middle lamella was also selectively degraded. Boundaries between sound and decayed wood were formed by springwood cells and occluded ray parenchyma cells.
KEYW *Phellinus (Fomes) pini*, cell wall degradation, hyphae, lignin, macrofibrillar bundles, ray parenchyma cells, degrading enzyme.

61 AUTH Boisselle, H. J.
DATE 1969
TITL Successful kiln drying of white pine for furniture stock.
PUBL Forest Products Journal. 19(3): 17-20.
ABST The roles humidity and temperature play in the successful kiln-drying of white pine are discussed at some length. Proper control of these two factors during the drying schedule is shown to be the key to minimizing several types of defects. A method for monitoring moisture content is also presented.
KEYW Kiln-drying, furniture stock, drying defects, moisture content.

62 AUTH Bordelon, M. A.
DATE 1978
TITL Some environmental and genetic parameters of cone production in *Pinus monticola* Dougl.
PUBL Moscow, ID: University of Idaho. 124 p. M.S. thesis.
ABST Ovulate strobilus loss was tallied from pollination to harvest. Frost damage and nonpollination were considered to be the major contributing factors in the loss. Trees that had been naturally pruned produced more cones than unpruned trees. Flower loss was family related.
KEYW Ovulate strobilus loss, cone production, pruning, frost damage.

63 AUTH Boyd, R. J., Jr.
DATE 1959
TITL Cleaning to favor western white pine—its effects upon composition, growth and potential values.
PUBL Journal of Forestry. 57: 333-336.
ABST Results of two cleanings to favor western white pine show that: (1) compositional improvements have been maintained at a high level during the 20 years since cleaning; (2) improvement in size and volume of potential crop trees resulted from the reduction in stand densities; and (3) similar cleaning operations under current economic conditions should yield substantial economic benefits.
KEYW Cleaning, stand composition, growth.

64 AUTH Boyd, R. J., Jr.
DATE 1961
TITL Deception Creek Experimental Forest.
PUBL Unpublished report on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Sciences Laboratory, Moscow, ID. 3 p.
ABST The Deception Creek Experimental Forest, located in the heart of the Coeur d'Alene National Forest, is dedicated to the development of better timber growing methods in the western white pine type. It is one of two experimental forests in the white pine type maintained for purposes of research and demonstration by the Intermountain Research Station. An index to major research projects is given, many of which include western white pine.
KEYW Deception Creek Experimental Forests.

65 AUTH Boyd, R. J., Jr.
DATE 1969
TITL Some case histories of natural regeneration in the western white pine type.
PUBL Research Paper INT-63. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 24 p.
ABST Trends of natural regeneration in some northern Idaho western white pine stands under a variety of silvicultural systems and habitat types are described. On moist sites, characterized by a *Thuja-Tsuga/Pachistima* habitat type, any of the even-aged silvicultural systems resulted in adequate regeneration with desirable species diversity within 5 to 10 years following cutting. Drier sites, represented by the *Abies grandis/ Pachistima* habitat type, were characterized by a prolonged regenerative period which

may exceed 20 years regardless of silvicultural method used. Selection cutting on these sites tends to favor nearly pure grand fir reproduction.

KEYW Shelterwood cut, clearcuts, seed tree cut, selection cut, regeneration.

66 AUTH Boyd, R. J., Jr.
DATE 1971
TITL Effects of soil fumigation on production of conifer nursery stock at two Northern Rocky Mountain nurseries.
PUBL Research Paper INT-91. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 19 p.
ABST Soil fumigation has improved production of Douglas-fir, western white pine, Engelmann spruce, and ponderosa pine stock at two Northern Rocky Mountain nurseries. The better fumigation treatments substantially reduced weeds and losses from diseases and insects, and generally resulted in larger stock with improved survival potential. Late summer fumigation with methyl-bromide-based fumigants has provided the most dependable overall improvement in nursery operation.
KEYW Soil fumigation, methyl-bromide, seedling growth.

67 AUTH Boyd, R. J., Jr.
DATE 1980
TITL Western white pine.
PUBL Proceedings Society of American Foresters. 1980: 94-95.
ABST The climatic, edaphic, and physiographic requirements are described.
KEYW Geographic distribution, ecological relationships.

68 AUTH Boyd, R. J., Jr., Deitschman, G. H.
DATE 1964
TITL Development of young western white pine plantations.
PUBL Research Note INT-18. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Study of two young western white pine plantations revealed their growth to be much faster than that of natural stands of comparable age. Data from a third plantation provided additional information on effects of site and density.
KEYW Plantation, site, density, stocking, diameter, height.

69 AUTH Bradner, M., Fullaway, S. V., Jr.
DATE 1927
TITL Size of timber, amount of defect—important factors in lumbering.
PUBL The Timberman. 29(2): 38-40.
ABST Compares values and production costs of sound western white pine logs according to size and position in tree.
KEYW Defect, timber size, lumbering, production costs.

70 AUTH Brandsberg, J. W.
DATE 1966
TITL A study of fungi associated with the decomposition of coniferous litter.
PUBL Pullman, WA: Washington State University. 105 p. Ph.D. thesis.
ABST The kinds and successions of fungi associated with decomposition of litter under *Abies grandis, Pinus monticola,* and *P. ponderosa* on sites located in Latah County, ID, were studied and an additional *P. ponderosa* site located on the Washington State University campus in Pullman, WA, was included in order to contrast fungi from old, well-established sites with those of a stand of more recent origin. A total of 151 species of fungi were isolated from a-0 and a-1 soil horizon materials. These included: 125 *Fungi imperfecti,* 13 *Ascomycetes,* and 10 species of *Phycomycetes.*
KEYW Decomposition of litter, *Fungi imperfecti, Ascomycetes, Phycomycetes.*

71 AUTH Brandsberg, J. W.
DATE 1969
TITL Fungi isolated from decomposing conifer litter.
PUBL Mycologia. 61: 373-381.
ABST A qualitative study was made of the mycofloras involved in the degradation of litter of *Abies grandis, Pinus monticola,* and *Pinus ponderosa* on sites located in northern Idaho. A total of 128 fungi were isolated. While no pronounced differences were noted in the mycofloras of the duff of different tree species, there was an evident succession of fungi as the leaf materials were degraded. Similarities and differences among species found during this study and those found by other investigators are noted.
KEYW Fungi forest litter, mycoflora.

72 AUTH Brewster, D. R.
DATE 1917
TITL Silvical research work in District One.
PUBL Forest Kaimin. Missoula, MT: University of Montana. p. 15-16, 34-35.
ABST The need to have full-time researchers to provide forest management information, data, and facts is presented. The type of data needed is discussed.
KEYW Data information needs.

73 AUTH Brewster, D. R., Larsen, J. A.
DATE 1925
TITL Girdling as a means of removing undesirable tree species in the western white-pine type.
PUBL Journal of Agricultural Research. 31: 268-274.
ABST On areas where seedlings, saplings, and larger trees of the species *Tsuga heterophylla* and *Abies grandis* are present, it is difficult to obtain establishment and growth of the more intolerant desirable species (*Pinus monticola* and *Larix occidentalis*). Girdling, burning, and poisoning are possible methods of disposing of the former species. Girdling with an ax notch in the spring or early summer was the most effective method tested.
KEYW Thinning, girdling.

74 AUTH Brown, J. K.
DATE 1978
TITL Weight and density of crowns of Rocky Mountain conifers.
PUBL Research Paper INT-197. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 56 p.
ABST Relationships between live and dead crown weight and d.b.h. (ranging from 0 to 40 inches), crown length, tree height, and crown ratio are presented for 11 conifer species in the Rocky Mountains. D.b.h. was highly correlated with crown weight; however, for most species, addition of height, crown length, and especially crown ratio improved precision. Site index and stand density improved precision of estimates slightly for about one-half of the species. Crown ratio accounted for most of the differences in crown weight between dominant and intermediate crown classes. Relationships between bole weights and d.b.h. and height are presented for trees up to 4 inches d.b.h.
KEYW Crown weight, crown length, crown ratio, foliage weights, branchwood weights, foliage density, branchwood density.

75 AUTH Brown, N. C.
DATE 1913
TITL Management of western white pine in northern Idaho.
PUBL Proceedings Society of American Foresters. 7-8: 327.
ABST Gives a general summary of current practices and knowledge concerning management of western white pine in northern Idaho.
KEYW Management, range, market, uses, silvicultural characteristics, rotation, yield.

76 AUTH Brundage, F. H.
DATE 1943
TITL Northwest woods have gone to war.
PUBL Journal of Forestry. 41: 654-658.
ABST Shortly after World War I, wood passed out of the picture for aircraft construction and other materials took its place. This article describes the return of wood for aircraft in World War II and the efforts being made to assure an adequate supply of the required quality. In spite of all this drive for war production, the author cautions against forgetting forestry by stopping selective cutting in pine, failing to leave an adequate source of seed supply in Douglas-fir, and easing up on fire protection.
KEYW Aero-grade lumber, log allocation, access roads, forest depletion.

77 AUTH Brush, W. D.
DATE 1951
TITL Knowing your trees: western white pine.
PUBL American Forests. 57: 28.
ABST A general description of western white pine, its uses, pests, and history.
KEYW Identification, range, description.

78 AUTH Buchanan, T. S.
DATE 1936
TITL An alinement chart for estimating number of needles on western white pine reproduction.
PUBL Journal of Forestry. 34: 588-593.
ABST A total of 6,809 measurements of crown length, crown width, and number of needles on young western white pines were made in British Columbia following the 1928 and the 1930 seasonal development. Of this total, 2,923 measurements of trees which were found to be normal in every respect were used in the construction of an alignment chart by the harmonized curves method. This chart permits the determination of number of needles when only crown length and crown width are known. Checking the chart statistically showed the aggregate difference to be 1.43 percent low, and the average deviation to be 39.5 percent, indicating that good results can be secured when measuring large numbers of trees, but that results for individual trees are not too reliable.
KEYW Reproduction, needle number, needle retention.

79 AUTH Buchanan, T. S.
DATE 1948
TITL Study of the mortality of young western white pine trees.
PUBL University of Idaho Bulletin. 43(6): 28-33.
ABST Outlines a cooperative research program on pole blight to investigate range and

distribution, a concise symptomatological picture, progress of the disease, possible causes, and possible silvicultural control methods.

KEYW Mortality, pole blight.

80 AUTH Buchanan, T. S.
DATE 1950
TITL Progress in research on pole blight of western white pine.
PUBL Northwest Science. 24(1): 34-35. Abstract.
ABST Since the inception of this cooperative program in June 1948, the Forest Service has made its lands and facilities available to the more active research agencies, and, through the Spokane Research Center, has initiated a series of cutting plots to test the effect of salvage cuttings on the progress of the disease in the residual stands. The Division of Forest Pathology has instituted an extensive series of inoculations testing the pathogenicity of certain fungi that have been most frequently isolated from pole blighted pines and the School of Forestry (University of Idaho) is making minor tests along similar lines in the summer of 1949 which it plans to continue in 1950 thereby providing the seriously needed information on range and distribution of pole blight. The School of Forestry has completed the field and computational work on 50 dissection trees from which a symptom description of the disease, capable of numerical expression, has been developed. Twenty-one plots have been established on which the progress and development of the disease will be followed. Thirty soils plots have been established in an effort to determine whether or not the disease is correlated with an underlying soils condition. Both the School of Forestry and the Division of Forest Pathology have made beginnings on examinations of the root systems of western white pine and the School of Forestry has initiated studies testing the possible virus aspects of the disease.
KEYW Pole blight, virus research agencies, salvage cuttings, aerial scouting.

81 AUTH Buchanan, T. S., Harvey, G. M., Welch, D. S.
DATE 1951
TITL Pole blight of western white pine: a numerical evaluation of the symptoms.
PUBL Phytopathology. 41: 199-208.
ABST Streaks of dead cambium, generally a few inches wide and several feet long, occurring on the main bole, were the only symptoms found upon detailed dissection of 50 trees that could be considered specific for pole blight. The following observable characteristics were reliable expressions of the severity of pole blight and were utilized in developing the symptom picture: (1) unexplained internodal resinosis on the main bole, (2) dead areas on the main bole, or flattened areas not directly associated with root crotches, (3) length of the last complete year's internode on the leader, (4) overall aggregate length of needle-bearing stem on the leader and upper crown branches, (5) length and color of needles in the upper crown, (6) density of the upper crown. Numerical values have been assigned to variations in these factors in such a way that an apparently healthy tree has a score of 0.0 and a dead tree a score of 4.0. Trees in various stages of pole blight will score between those extremes.
KEYW Pole blight, pole blight symptoms.

82 AUTH Callaham, R. Z.
DATE 1965
TITL Hybridizing pines with diluted pollen.
PUBL In: Proceedings, 8th Southern Conference on Forest Tree Improvement; Savannah, GA. p. 110-111.
ABST Valuable lots of pine pollen can be diluted generally to 30 percent live pollen with no effect on the proportion of seeds that are sound. Dilutions having only 10 or 20 percent viable pollen produced significantly fewer total seeds per cone. The possibilities of diluting pine pollen were studied in the context of a series of interspecific hybridizations carried out at Placerville, CA.
KEYW Hybrids, pollen dilution.

83 AUTH Callaham, R. Z., Steinhoff, R. J.
DATE 1966
TITL Pine pollens frozen five years produce seed.
PUBL In: Joint Proceedings, 2d Genetics Workshop, Society of American Foresters and Seventh Lake States Forest Tree Improvement Conference; October 21-23, 1965; St. Paul, MN. p. 94-101.
ABST This paper reports in vitro germination of pollen and in vivo seed production by pollens stored at –20 °C for up to 5 years. Pollen germinability in vitro indicates pollen viability, but only use of pollen in vivo will show its ability to set cones and to produce sound seeds. Brief freezing of pollen for a few days between extraction and use significantly increased yield of filled seed. Significant reductions in yield of sound seeds occurred after 3 years of freezing.
KEYW Pollen storage, pollen germination.

84 AUTH Callaham, R. Z., Steinhoff, R. J.
DATE 1966
TITL Pine pollens frozen five years produce seed.
PUBL Research Paper NC-6. St. Paul, MN: U.S. Department of Agriculture, Forest Service,

North Central Forest Experiment Station. 8 p.

ABST The ability of pollens of five species of pines to set cones, to produce seed, and to yield filled seed after cold storage up to 5 years was determined. Pollen samples for each species were frozen at –20 °C for a few days and for 1, 2, 3, and 5 years. Two other samples for each species were refrigerated at about 5 °C for 1 and 2 years. Each pollen sample was tested for germination in vitro in the year in which it was used. Brief freezing of pollen for a few days between extraction and use significantly increased yield of filled seed. Storing pollen in a freezer for 1 or 2 years produced fewer filled seeds than fresh pollen. After 3 and 5 years of freezing, the reductions in yield of sound seeds were significant, becoming progressively greater as storage time increased. However, freezing of pollen did not influence its ability to pollinate strobili and to permit seed coats to form.

KEYW Pollen freeze drying, controlled pollination, pollen storage.

85 AUTH Canadian Department of Agriculture
DATE 1953
TITL Pitch moth infestation in western white pine.
PUBL Canadian Department of Agricultural Science Service Bi-monthly Progress Report. 9(1): 3-4.
ABST During November 1952, personnel of the Laboratory of Forest Biology, Vernon, BC, visited a timber sale at Magna Bay, Shuswap Lake, to determine if insects were a factor in the unhealthy condition of western white pine on the area. The inspections revealed that two species of pitch moths, tentatively identified as *Dioryctria zimmermani* and *Vespamima novaroensis*, were present in epidemic proportions. It was estimated that about 50 percent of the stand of white pine over 6 inches d.b.h. was infested in varying degrees. The intensity of the infestation indicated that it extended beyond the area of the timber sale (2,000 acres).
KEYW Pitch moth, *Dioryctria zimmermani, Vespamima novaroensis.*

86 AUTH Carolin, V. M., Coulter, W. K.
DATE 1963
TITL Eradicating European pine shoot moth in commercial nurseries with methyl bromide.
PUBL Research Paper PNW-1. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 11 p.
ABST Treatments to control European pine shoot moth with methyl bromide were successful on mugho, eastern white, Austrian, lodgepole, and western white pine after long treatment periods.
KEYW European pine shoot moth, methyl bromide, insect control, chemical control.

87 AUTH Castles, J. R.
DATE 1961
TITL The role of white pine in Region 1.
PUBL In: R-1 Annual Blister Rust Control Report 60. Missoula, MT: U.S. Department of Agriculture, Forest Service. 3 p.
ABST White pine lumber production, lumber values, and growth capabilities in northern Idaho were discussed. From a timber quality, growth potential, total value, or stumpage value viewpoint, white pine was viewed as a premium species.
KEYW Inventory data, ownership.

88 AUTH Cech, M. Y.
DATE 1966
TITL New treatment to prevent brown stain in white pine.
PUBL Forest Products Journal. 16: 23-27.
ABST This test showed that chemical brown stain in white pine lumber can be practically eliminated if lumber is treated with an aqueous solution of sodium fluoride immediately after sawing. Heavy brown stain developed in untreated lumber that had been close-piled for 3 days or longer before kiln drying.
KEYW Brown stain, sodium fluoride treatment, kiln drying.

89 AUTH Chapman, J. A.
DATE 1963
TITL Field selection of different log odors by scolytid beetles.
PUBL Canadian Entomologist. 7: 673-676.
ABST Air from a common source was divided and each portion blown through a separate large box containing logs from one tree species. Air from each box was conducted away and released between two window flight traps. Four coniferous tree species were represented in the test. Bark and ambrosia beetles from natural populations responded positively to log odors in the released air. There were differences in the response of beetle species to the log odors represented.
KEYW Scolytidae, log odor.

90 AUTH Chard, R.
DATE 1975
TITL A stand of western white pine at Castle O'er Forest.
PUBL Scotland Forestry. 29(2): 94-101.
ABST Some particulars are given of a small stand of western white pine as further indication that early pruning of five-needled pines reduces

deaths from white pine blister rust. The potential of *Pinus monticola* for high yields of very stable softwood is indicated.

KEYW Scotland, pruning, yield.

91 AUTH Ching, T. M., Ching, K. K.
DATE 1964
TITL Freeze-drying pine pollen.
PUBL Plant Physiology. 39: 705-708.
ABST Two lots of western white pine pollen were air-dried, or stored at 3 degrees for 6 weeks, prior to freeze-drying. Viability and moisture content of control, air-dried, and cold-stored pollen freeze-dried for 15, 30, 45, 60, 90, and 120 minutes were determined. Air-drying for 4 hours, or refrigerating slightly air-dried material for several weeks then freeze-drying for 30 to 60 minutes, was found sufficient to remove free water and retain high viability. Freeze-drying apparently alters the selective permeability of the cellular membrane, as increased amounts of electrolytes, amino acids, carbohydrates, and compounds with maximal absorbance at 260 microns were found in leachate of treated pollen. Change in temperature during freeze-drying of the pollen was recorded.
KEYW Pollen freeze drying.

92 AUTH Ching, T. M., Slabaugh, W. H.
DATE 1966
TITL X-ray diffraction analysis of ice crystals in coniferous pollen.
PUBL Cryobiology. 2: 321-327.
ABST X-ray diffraction analysis was used to discern the relationship between ice formation and killing caused by freezing in pollen. By means of a specially designed low temperature sample holder, ice crystals were detected by x-ray diffraction in Douglas-fir and western white pine pollen containing 36 percent or more water at about –25 °C. Pollen samples with detectable ice crystals were killed by the low temperature. The viability of some pollen samples containing about 30 percent water was reduced by freezing but without detectable ice crystals. This indicates a possibility of separating ice crystal formation and other effects caused by freezing temperatures in biological materials.
KEYW X-ray diffraction analysis, ice crystals, pollen mortality, water content, seed germination.

93 AUTH Chow, S. Z.
DATE 1971
TITL Determining veneer surface inactivation by a reflectance colorimeter.
PUBL Forest Products Journal. 21: 19-24.
ABST The color-intensity difference of veneer surfaces before and after drying, measured with a reflectance colorimeter in the 520 mμ region, was found to relate to the bond quality of plywood made from the veneers of three softwood species: western white pine, western white spruce, and coast Douglas-fir; and one hardwood, trembling aspen. Shear strength of plywood decreased as the color-intensity difference increased. The wood failure percentage decreased with increasing color-intensity difference which depended on the wood species. The wood failure then increased as the color-intensity difference increased as a result of degradation of the fibers on the wood surface. The present method offers a technique for evaluating the severity of the effect of veneer drying conditions on surface inactivation. A suitable drying schedule can be developed that will reduce poor bonds to an acceptable level.
KEYW Veneer surface, bond quality, color intensity.

94 AUTH Clark, J. W.
DATE 1957
TITL Comparative decay resistance of some common pines, hemlock, spruce, and true fir.
PUBL Forest Science. 3(4): 314-320.
ABST Heartwood samples from 14 coniferous tree species were exposed to decay by *Poria monticola*, *Lensites sepiaria*, and *L. trabea*, and then rated according to comparative resistance. The range of resistance among samples of the same woods was shown to be greater for those species exhibiting greater resistance when compared with species of lesser resistance.
KEYW Decay fungi, decay resistance, decay resistance rating.

95 AUTH Cline, R. G.
DATE 1974
TITL Seasonal, diurnal, and spatial water use and water relations of selected forest species.
PUBL Pullman, WA: Washington State University. 68 p. Ph.D. thesis.
ABST Soil moisture, leaf diffusive resistance, leaf water potential, and leaf osmotic potential measurements were made on the soil, one tree species, and three woody brush species on north and south aspects in the Priest River Experimental Forest of northern Idaho. Soil moisture losses appeared to be related to the energy loading associated with aspect, vegetation type, and the maximum springtime water content of the soils. *Acer glabrum* and *Pinus monticola* occurred on both aspects. *Alnus sinuata* and *Physocarpus*

malvaceus occurred only on north and south aspects, respectively. Lower water loss rates were observed on a fully occupied north aspect site dominated by coniferous tree species. The *Pinus* on this site attained osmotic and leaf water potentials near –25 bars and leaf diffusive conductance near 0.06 cm/s. *Pinus* maintained a uniform osmotic potential between –20 and –25 bars throughout the year which appeared to fluctuate during the growing season in accordance with incident solar radiation. Leaf diffusive conductance appeared to be controlled during the day by a combination of atmospheric demand, soil moisture availability, and plant adaptation to water stress. Stomatal control of leaf water potential was evident in *Pinus* on both aspects.

KEYW Water use, water relations, soil moisture, leaf osmotic potential, leaf water potential.

96 AUTH Cline, R. G., Campbell, G. S.
DATE 1976
TITL Seasonal and diurnal water relations of selected forest species.
PUBL Ecology. 57: 367-373.
ABST Leaf diffusive conductance, leaf water potential, and leaf osmotic potential measurements were made on one tree species and three woody brush species on north and south aspects in the Priest River Experimental Forest of northern Idaho. Douglas maple (*Acer glabrum*) and western white pine (*Pinus monticola*) occurred on both aspects. Sitka alder (*Alnus sinuata*) and mallow ninebark (*Physocarpus malvaceus*) occurred only on north and south aspects, respectively. The *Pinus* on the south aspect attained osmotic and leaf water potentials near –25 bars and leaf diffusive conductances near 0.06 cm/s. The pines maintained a uniform osmotic potential between –20 and –25 bars throughout the year. Stomatal control of leaf water potential was evident in pines on both aspects.
KEYW Diffusion resistance, Idaho, osmotic potential, water potential.

97 AUTH Cobb, F. W., Miller, D. R.
DATE 1968
TITL Hosts and geographic distribution of *Scirrhia pini,* the cause of red band needle blight in California.
PUBL Journal of Forestry. 66: 930-933.
ABST *Scirrhia pini* was first identified as the cause of a needle disease of pine in California in January 1966. Over 300 plantings, natural stands, and nurseries were subsequently examined to determine the geographic and host range of the fungus. Eight infection centers were found—all in plantations or ornamental plantings in four areas along the northern coast. The fungus was found on *Pinus radiata, P. attenuata, P. attenuata* x *radiata,* and *P. contorta.* A fungus closely resembling *S. pini* was found on native *P. monticola* in northern California and has tentatively been identified as *Lecanosticta* sp.
KEYW *Scirrhia pini*, red band needle blight, *Lecanosticta*.

98 AUTH Coffen, D. O., Bordelon, M. A.
DATE 1981
TITL Stem breakage effect on cone and pollen production in *Pinus monticola* (Dougl.).
PUBL Research Note INT-312. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Two studies in a western white pine blister rust resistance breeding arboretum/seed orchard examined the effect of stem breakage on cone and pollen production. Research was based on 4 years of data from 1,529 trees 15 to 29 years of age. Cone and pollen production were increased by breakage of the main stem in the upper crown. Top pruning may be a viable technique for stimulating flowering in seed orchards of western white pine.
KEYW Cone production, pruning for cone production.

99 AUTH Copeland, O. L., Jr.
DATE 1956
TITL Preliminary soil-site studies in the western white pine type.
PUBL Research Note 33. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Results of this study suggest a strong relationship between certain easily determined soil characteristics and site index in the western white pine type. Soil characteristics used in this analysis were effective depth, depth to zone of greatly reduced permeability, and available water-holding capacity.
KEYW Soil characteristics, site index, soil depth, water-holding capacity.

100 AUTH Copeland, O. L., Jr.
DATE 1958
TITL Soil-site index studies of western white pine in the Northern Rocky Mountain region.
PUBL Proceedings Soil Science Society of America. 22: 268-269.
ABST This paper reports results of a study on 37 plots that show the relationships of certain physical soil properties to site index (at age

50) of western white pine. Site index is correlated significantly with effective soil depth, depth to the zone of reduced permeability, and the available water-holding capacity of the top 3 feet of soil. Regression equations and confidence limits at the 5 percent level of significance are included. Applications of these relationships in forest management are discussed.

KEYW Soil-site index, site index, soil properties.

101 AUTH Copeland, O. L., Jr., Leaphart, C. D.
DATE 1955
TITL Preliminary report on soil-rootlet relationships to pole blight of western white pine.
PUBL Research Note 22. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Results of a coordinated soil-rootlet mortality study in 1954 indicated that the severity of the pole blight disease of western white pine is significantly correlated with certain physical soil characteristics and rootlet mortality.
KEYW Soil root relationships, pole blight.

102 AUTH Copes, D. L.
DATE 1980
TITL Anatomical symptoms of graft incompatibility in *Pinus monticola* and *P. ponderosa*.
PUBL Silvae Genetica. 29: 77-82.
ABST Internal symptoms of graft incompatibility were examined in unions of 6-month to 8-year-old ponderosa and western white pine grafts. Internal symptoms in both species could be detected in the second and third growing seasons following grafting. Common incompatibility symptoms were phloem and cortex necrosis, suberization, internal periderm formation, and invaginated xylem areas.
KEYW Graft rejection, vegetative propagation, seed orchards.

103 AUTH Cox, W. T.
DATE 1911
TITL Reforestation on the National Forests.
PUBL Bulletin 98. Washington, DC: U.S. Department of Agriculture, Forest Service. 57 p.
ABST Western white pine was considered a very valuable timber tree in certain portions of the Northwest in 1911. Characteristics noted were: It grows rapidly, produces heavy stands of valuable timber, and may be grown on rough, steep mountainsides. Seed of this species is not easily obtained as a general rule, so that it is necessary to do some planting. In nurseries the seed comes up unevenly and therefore requires treatment, such as stratification every winter, or soaking before being sown. This bulletin recommends that western white pine should be used extensively in reforestation work of the National Forests of northwestern Montana at altitudes of from 3,000 to 5,500 feet, throughout northern Idaho at similar altitudes, and in western Washington below 4,500 feet. Every effort should be made to obtain larger quantities of seed.
KEYW Reforestation, seed collection, direct seeding, seed cost, seed germination, seed per acre, seed yield, seed extraction, seed storage, rodents that feed on seed, rodent control.

104 AUTH Critchfield, W. B., Krugman, S. L.
DATE 1967
TITL Crossing the western pines at Placerville, California.
PUBL Seattle, WA: University of Washington Arboretum Bulletin. 30(4): 78-81.
ABST The results of hybridizing the western pine species by the Institute of Forest Genetics are described and discussed. It has been found that the hard (yellow) pines can generally be crossed successfully only with similar species native to the same part of the world. In contrast, the soft (white) pines of the Western Hemisphere have been crossed successfully with soft pines of the Eastern Hemisphere. The hybrids produced by the institute have been found to have value in both the field of forestry and in improving man's environment.
KEYW Hybrids.

105 AUTH Critchfield, W. B., Little, E. L., Jr.
DATE 1966
TITL Geographic distribution of the pines of the world.
PUBL Miscellaneous Publication 991. Washington, DC: U.S. Department of Agriculture, Forest Service. 97 p.
ABST Range maps, a short description of the pines of the world, and selected citations are included.
KEYW Geographic distribution.

106 AUTH Cummings, L. J., Kemp, P. D.
DATE 1940
TITL Forest increment in north Idaho.
PUBL Forest Survey Release 18. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 74 p.
ABST The total land area in northern Idaho is approximately 13 million acres, of which more than 10 million was forest land in 1940. Of this, almost half was unreserved commercial forest in a growing status. The current

annual increment in growing unreserved commercial forests amounted to 636 million bd ft, of which 165 million bd ft or 26 percent was white pine. Current annual drain of timber from the commercial forest (both growing and nongrowing) averaged 712 million bd ft, of which 366 million or 51 percent was white pine. Tables of net current annual board foot increment are given by forest type for counties of northern Idaho.

KEYW Forest increment.

107 AUTH Daubenmire, R.
DATE 1952
TITL Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification.
PUBL Ecological Monographs. 22: 301-330.
ABST The conifer-dominated forests of northern Idaho and adjacent Washington are classified into 13 climax plant associations, divided among four vegetation zones. The associations recognized reflect primarily the reproductive abilities of vascular plant species in the face of competition. Soil pH is closely related to the association sequence, and cation capacity shows a slight tendency to increase upward through the altitudinal series. Moisture equivalent and percentage saturation with hydrogen ions show little relationship to the vegetation matrix. Some practical applications of the findings to forest and wildlife management are suggested. *Pinus monticola* is listed in the following associations (habitat types): *Abies grandis/Pachistima myrsinites*; *Thuja plicata-Tsuga/Pachistima myrsinites*; *Thuja plicata/Pachistima myrsinites*; *Thuja plicata-Tsuga/Oplopanax horridum*; *Picea engelmannii/Pachistima myrsinites*.
KEYW Vegetation classification, habitat type, ecologic classification, climax association, vegetation association.

108 AUTH Daubenmire, R.
DATE 1953
TITL Classification of the conifer forests of eastern Washington and northern Idaho.
PUBL Northwest Science. 27: 17-24.
ABST Western white pine is listed in the following tree unions: major seral role in all *Thuja plicata* and *Picea engelmannii* unions; minor seral role in the *Abies grandis/Pachistima myrsinites* union.
KEYW Habitat type, vegetative classification, tree unions.

109 AUTH Daubenmire, R.
DATE 1953
TITL Nutrient content of leaf litter of trees in the Northern Rocky Mountains.
PUBL Ecology. 34: 786-793.
ABST Nutrient content of *P. monticola* leaf litter from various habitat types ranged as follows: nitrogen, 0.45-0.59 percent (average 0.54 percent); phosphorus, 0.06-0.10 percent (average 0.07 percent); potassium, 0.18-0.28 percent (average 0.22 percent); calcium, 0.55-0.90 percent (average 0.55 percent).
KEYW Leaf litter, leaf litter nutrient content, leaf litter nitrogen, leaf litter phosphorus, leaf litter potassium, leaf litter calcium.

110 AUTH Daubenmire, R., Daubenmire, J.
DATE 1968
TITL Forest vegetation of eastern Washington and northern Idaho.
PUBL Bulletin 60. Pullman, WA: Washington State Agricultural Experiment Station.
ABST Data on population structure of trees, dominance, and frequency among shrubs and herbs, responses to disturbance, animal life, topography, soil, and total known geographic distribution are given. A key is presented for the identification of habitat types. Concepts discussed in relation to the data obtained include the principle of competitive exclusion, continuity of variation, species diversity, and the synecologic significance of basal area.
KEYW Habitat types, population structure.

111 AUTH Davidson, R. W.
DATE 1950
TITL A western white pine twig canker.
PUBL Plant Disease Reporter. 34: 99.
ABST The fungus *Curcurbidothis pithyophila* was collected on twigs of *Pinus monticola* near Nakusp, BC, August 29, 1949. This fungus was fruiting on numerous cankered areas of small twigs in the lower crown of one pole-sized tree. A second specimen was collected by E. P. Meinecke and J. S. Boyce on twigs of *Pinus monticola* in Columbia National Forest (now the Gifford Pinchot National Forest), WA, in August 1942. This indicates that it may be widespread in the western white pine area. No information is available regarding its prevalence or pathological importance.
KEYW *Curcurbidothis pithyophila*, twig canker.

112 AUTH Davidson, R. W., Robinson-Jeffrey, R. C.
DATE 1965
TITL New records of *Ceratocystis europhioides* and *C. huntii* with *Verticicladiella* imperfect stages from conifers.
PUBL Mycologia. 57: 488-490.
ABST Collection of *C. huntii* was made on standing dead *P. monticola* infested with *Dendroctonus ponderosae* and ambrosia beetles at

Mount St. Helens, WA, July 1962. Perithecia were common on beetle-killed trees.

KEYW *Ceratocystis huntii*, *Verticicladiella*, imperfect stage, *Dendroctonus ponderosae*.

113 AUTH Davis, K. P.
DATE 1936
TITL Test of pruning equipment and methods in western white pine.
PUBL Applied Forestry Note 76. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 9 p.
ABST The best all-around tool of the group tested was the 12-inch hand saw. For most high pruning work in western white pine, the pole saw seems preferable to the ladder method. The ladder method is advisable only where limbs to be cut are large and where the density of the stand is such that a ladder can be transported with reasonable ease through the woods.
KEYW Pruning equipment, pruning methods.

114 AUTH Davis, K. P.
DATE 1940
TITL Economic aspects of managing western white pine forests.
PUBL Northwest Science. 14: 26-32.
ABST In 1940, the Government faced an increasingly larger management problem as forest lands reverted from private ownership. The future of white pine was a big question mark, but the best guess was that white pine sawlogs would continue to be the main money crop and the economic aspects of public forestry were going to demand more and more thorough consideration. Merchantable yields per rotation are given for one-cut and four-cut management plans.
KEYW Economics, merchantable yield, management plans.

115 AUTH Davis, K. P.
DATE 1942
TITL Economic management of western white pine forests.
PUBL Technical Bulletin 830. Washington, DC: U.S. Department of Agriculture, Forest Service. 78 p.
ABST A case analysis of the cost of growing western white pine forests on a long-term basis was presented. Significant conclusions from this analysis were: (1) the general superiority of a partial-cutting over a single-cutting plan of management; (2) the financial difficulties resulting from a market for only one species, western white pine, in a forest of several species; (3) the complete dependence on western white pine as the pay species in the region; (4) with a fully regulated forest operated on a partial-cutting plan, estimated returns slightly exceeded direct costs, indicating that in the long run the public can grow white pine forests on a nonprofit basis; (5) opportunities for private investment in long-time timber growing are slight.
KEYW Economic management.

116 AUTH Davis, K. P., Klehm, K. A.
DATE 1939
TITL Controlled burning in the western white pine type.
PUBL Journal of Forestry. 37: 399-407.
ABST Controlled burning was a highly controversial procedure, but the authors show that under certain conditions when adequate precautionary measures are taken it has a definite place in western white pine forest management. The authors describe the conditions under which it is useful, the precautionary measures that must be taken, the results that may be expected, and the cost of the operation.
KEYW Controlled burning, broadcast burning.

117 AUTH Deitschman, G. H.
DATE 1966
TITL Diameter growth of western white pine following precommercial thinning.
PUBL Research Note INT-47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST Precommercial thinning treatments of western white pine stands in northern Idaho were broadly classified as heavy thinning and light-to-moderate thinning. Data from periodic measurements of 35 plots, including unthinned control plots, were analyzed for differences in the diameter growth of potential crop trees. Only heavy thinning produced a significant response. Although the average diameter growth increase did not exceed 0.03 inch per year, stands thinned at 55 to 65 years of age have maintained this advantage for periods up to 40 years.
KEYW Diameter growth, thinning precommercial.

118 AUTH Deitschman, G. H., Green, A. W.
DATE 1965
TITL Relations between western white pine site index and tree height of several associated species.
PUBL Research Paper INT-22. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 28 p.
ABST Records from 108 permanent plots in northern Idaho western white pine stands were analyzed to develop methods for estimating

comparative height-growth capabilities among major species represented. Equations and graphs published here permit prediction of average dominant-codominant height of five associated species from site data that include stand age and white pine height or site index. Other equations provide estimates of white pine site index from known age and height of the alternate species. Many of the source data come from plots in unmanaged second-growth stands; hence, species-height relations shown here might differ from those in plantations or stands under management.

KEYW Site index, comparative height.

119 AUTH Deitschman, G. H., Pfister, R. D.
DATE 1973
TITL Growth of released and unreleased young stands in the western white pine type.
PUBL Research Paper INT-132. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 14 p.
ABST Effects of release by removal of a residual overstory and by cleaning treatments were measured over a 30-year period in young mixed-conifer stands on moist sites in northern Idaho. Increasing time of overwood retention caused rapid loss of the more intolerant species and corresponding reduction in subsequent alternatives for crop-tree selections. Cleaning effectively promoted the growth of leave trees, principally western white pine, but the amount and duration of benefit was decreased by an aggressive reappearance of tolerant and intolerant species, especially in heavily cleaned plots.
KEYW Pruning, mixed stand.

120 AUTH Denton, R. E.
DATE 1960
TITL Association of aphids of the genus *Pineus* with needle blight of western white pine.
PUBL Unpublished report on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID. 18 p.
ABST Abnormal symptoms of crown deterioration, or needle blight, reached serious proportions in western white pine stands in the Inland Empire by 1960. Preliminary investigations showed that needle blight is a complex problem involving both fungi and insects; aphids of the genus *Pineus* were one of the suspected possible causes of needle blight. Studies indicated that one undetermined species of *Pineus* apparently is correlated with crown deterioration symptoms. It is distinguished by the scalelike appearance of the nymphs. This aphid not only is confined to the lower portions of tree crowns, where symptoms of needle blight become evident first, but it is more numerous on trees in advanced stages of crown deterioration. Data showed that the number of aphids on a twig is not excessive, in the sense of being massed. This suggests that if aphids are responsible for needle blight of western white pine they must inject a toxin into the shoots or else they are carriers of a disease organism.
KEYW Needle blight, aphids, *Pineus*.

121 AUTH Denton, R. E., Leaphart, C. D.
DATE 1959
TITL Symptoms of abnormal crown deterioration in western white pine stands.
PUBL Research Note INT-69. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST The cause of crown deterioration reported here is still undetermined. This paper presents information assembled in 1958 concerning the nature of the problem, describes the symptoms and characteristics of affected trees, and suggests what research may be necessary to determine causative agent or agents.
KEYW Crown deterioration, pole blight, aphids, *Pineus, Bifusella, Lophodermium.*

122 AUTH Deuber, C. G.
DATE 1942
TITL The vegetative propagation of eastern white pine and other five-needled pines.
PUBL Journal of Arnold Arboretum. 23: 19.
ABST The rootings of numerous collections of dormant stem cuttings of *Pinus strobus* were tested as well as those of lesser numbers of cuttings of *P. monticola*, *P. parviflora*, *P. flexilis*, *P. koraiensis*, *P. peuce*, *P. cembra*, and *P. lambertiana*. Low rooting (5.5 percent) occurred in one collection of cuttings from one tree of *P. monticola*.
KEYW Rooting.

123 AUTH Dickerman, M. B.
DATE 1947
TITL Lumber production gains in the Northern Rocky Mountain Region.
PUBL Research Note 53. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Western white pine figures for the Northern Region were 242,960 thousand bd ft.
KEYW Production lumber.

124 AUTH Dickerman, M. B.
DATE 1947

TITL 1946 - a peak year in pole production.
PUBL Research Note 54. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Pole production for western white pine was 390 poles, less than 0.1 percent of the total produced.
KEYW Production poles.

125 AUTH Dickerman, M. B.
DATE 1949
TITL Lumber production tops 24-year record in Northern Region.
PUBL Research Note 75. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Lumber production for western white pine is listed as 269,836 thousand bd ft in the Northern Region of the Forest Service during 1948.
KEYW Production lumber.

126 AUTH Doll, G. B.
DATE 1940
TITL Grazing in relation to coniferous and vegetational reproduction in the cut-over white pine areas of the Clearwater drainage of northern Idaho.
PUBL Moscow, ID: University of Idaho. 85 p. M.S. thesis.
ABST Past grazing practices in this region have allowed some areas to be heavily grazed over a long period of time while others have remained virtually untouched. A study of these areas reveals the changes that have taken place and also suggests a type of management that may prevent either extremes in the future. The degree to which a given area may be grazed should be based on factors leading to a sustained yield management plan whether this management is primarily to perpetuate timber reproduction or forage for livestock. In this white pine region, cut-over areas should be grazed to obtain complete utilization of the forage "crop" present without eliminating desirable forage species or unduly injuring coniferous reproduction.
KEYW Grazing, reproduction.

127 AUTH Dominik, J.
DATE 1975
TITL Insect pests and parasitic fungi occurring on western white (*Pinus monticola*), pitch (*P. rigida*), and jack (*P. banksiana*) pines in the Experiment Forest at Rogow.
PUBL Sylvan. 119(11): 29-34.
ABST The purpose of this work was to determine the degree of intensity of damage caused by indigenous insects, mammals, and fungi in young plantations, thickets, and older stands of *Pinus monticola, P. rigida,* and *P. banksiana,* when compared with the damage caused by these organisms in *P. sylvestris* stands of a comparable age. It was found that from the viewpoint of forest protection a considerable resistance against *Lophodermium pinastri*, significantly lower susceptibility to attacks by *Rhyacionia buoliana* and *Exoteleia dodecella* are advantages of *P. monticola* when compared with *P. sylvestris*. On the other hand, the high susceptibility to *Cronartium ribicola* is a negative feature of *P. monticola*. Species of pines of North American origin are by far more frequently damaged by game.
KEYW Insect pests, parasitic fungi, Poland, resistance, *Lophodermium pinastri, Rhyacionia buoliana, Exoteleia dodecella,* game damage.

128 AUTH Duffield, J. W., Righter, F. I.
DATE 1953
TITL Annotated list of pine hybrids made at the Institute of Forest Genetics.
PUBL Research Note 86. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 9 p.
ABST The following observations are made concerning *P. monticola:* x *P. strobus*—of special interest because it has outgrown both parent species; x *P. griffithii*—outgrows western white pine and appears less susceptible to blister rust, more drought resistant than Himalayan white pine, but may not be completely cold hardy; x *P. peuce*—no faster growth than western white pine but may combine cold hardiness and moderate resistance to blister rust; x (*peuce* x *strobus)*—grows about the same as *monticola* x *strobus;* blister rust resistance tests incomplete.
KEYW Hybrids, *Pinus monticola* x *P. strobus, Pinus monticola* x *P. griffithii, Pinus monticola* x *P. peuce, Pinus monticola* x (*P. peuce* x *P. strobus*).

129 AUTH Duffield, J. W., Snyder, E. B.
DATE 1958
TITL Benefits from hybridizing American forest tree species.
PUBL Journal of Forestry. 56: 809-815.
ABST Discusses reasons for breeding hybrids and reviews accomplishment in this field of research.
KEYW Hybridization, hybrid vigor, interspecific hybridization.

130 AUTH Ehrlich, J.
DATE 1939

TITL A preliminary study of root diseases in the western white pine type.

PUBL Station Paper 1. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 66 p.

ABST In the areas sampled (on the Coeur d'Alene National Forest, ID) root diseases were common in mature western white pine, the most common being shoestring root rot caused by *Armillaria mellea,* a fungus which is apparently a widespread saprophyte in the soils of the white pine type. Because evidence of root infection by this fungus was found in apparently healthy trees as well as in obviously unhealthy and dying trees, and because increment reductions attributable to infection have occurred for many years, it was concluded that infection may be of long standing in certain trees. The following data are included: increment above roots with most and with least infection; percentage of trees infected in three site-quality classes; percentage of trees infected in four tree-height classes; percentage of trees infected in three site-moisture classes; percentage of trees infected in three classes based on number of snags and stumps within a half chain; crown color and degree of root infection; density of crown and degree of root infection; height, aspect, site quality, and site moisture for beetle-attacked trees; incidence of infection by *A. mellea* in beetle-attacked trees.

KEYW *Fomes annosus*, height, site quality, site moisture, foliage color, root collar, density, mountain pine beetle, root diseases, *Armillaria mellea.*

131 AUTH Ehrlich, J., Baker, L. K.

DATE 1942

TITL Preliminary study of dying of young white pine on Coeur d'Alene and Kaniksu Forests.

PUBL Report to files, University of Idaho and U.S. Department of Agriculture, Forest Service. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID. 67 p.

ABST The purpose of this study was to determine the cause of mortality of white pine. The authors could find no convincing evidence of any obvious cause. They provide two explanations: (1) that mortality represented merely the natural removal of white pine from marginal sites; (2) that mortality was the result of attacks by some fungus or insect or combination of organisms, either indigenous or locally new, aided perhaps by recently lowered resistance of the tree, especially on suboptimal sites, resulting from recently unfavorable weather. The following data are included: d.b.h., height, age, condition of crown and foliage grouped by health of tree, break in increment by year, condition of trunk and roots by individual and area, moistness of site and soil texture, soil profile depth, color, and constituents and parent material, fungi isolated and cultured from diseased trees (*Cryptosporium, Endobotryella,* and *Scopularia*).

KEYW Tree mortality, crown condition, root condition, soil texture, *Cryptosporium, Endobotryella*, *Scopularia,* trunk condition, soil profile.

132 AUTH Eis, S.

DATE 1976

TITL Association of western white pine cone crops with weather variables.

PUBL Canadian Journal of Forest Research. 6: 6-12.

ABST Records of western white pine cone counts for 21 years were analyzed with seven meteorological variables to find if any combinations of available weather factors were associated with the induction of reproductive buds and successful development of the strobili. The weather in three periods before the physical initiation of the potentially reproductive cycle showed association with cone counts: (1) sunny weather in June, 39 months before cone maturation; (2) warm, sunny, dry weather in September and October, 36 and 35 months before cone maturation; and (3) warm, sunny, dry weather with wide daily temperature range in June and July, 27 and 26 months before cone maturation, appeared to promote differentiation of potentially reproductive buds. During and after the initiation of bud primordia, the weather in four periods appeared to be associated with cone production: (1) warm and possibly wet weather in August, September, and October, 25 to 23 months before cone maturation; (2) rain in the third quarter of July, 4 weeks after pollination and 14 months before cone maturation; (3) warm temperatures in September, October, and November, 12 to 10 months before cone maturation; and (4) sunny, warm, dry weather in May, 4 months before cone maturation, appeared to be beneficial to cone development.

KEYW Cone crops, weather.

133 AUTH Eis, S., Garman, E. H., Ebell, L. F.

DATE 1965

TITL Relation between cone production and diameter increment of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), grand fir (*Abies grandis* (Dougl.) Lindl.) and western white pine (*Pinus monticola* Dougl.).

PUBL Canadian Journal of Botany. 43: 1533-1539.

ABST Cone count records for a 28-year period on 80 Douglas-fir, 14 grand fir, and nine western white pine were statistically analyzed with the annual diameter increment to evaluate the relationship between cone and wood production. The width of annual rings was depressed only during the years of cone production, suggesting that carbohydrates used in cone development were supplied from current photosynthesis rather than from stored reserve. The initiation of reproductive buds did not appear to be dependent on the level of carbohydrates in a tree, and the role of carbohydrates was probably only that of nutrition during cone development. Maturing cones did not exhibit any inhibitory effect on initiation of new flowering buds. Different species may require a different combination of climatic factors for initiation of flowering buds.

KEYW Cone production, diameter increment, annual ring width, annual ring index, carbohydrates.

134 AUTH Eslyn, W. E., Kirk, T. K., Effland, J. J.
DATE 1974
TITL Changes in the chemical composition of wood caused by six soft-rot fungi.
PUBL Phytopathology. 65: 473-476.
ABST Standardized blocks of alder, poplar, and pine were decayed by six soft-rot fungi (*Graphium* sp., *Mondicys* sp., *Paecilomyces* sp., *Papulospora* sp., *Thielavia terristris*, and *Allesheria* sp.), all of which had been isolated from pulp chip storage piles. Samples of the woods at different weight losses were analyzed for lignin, glucan (cellulose), xylan, and mannan (hemicelluloses) to allow calculation of the depletion in these major components caused by the fungi. Carbohydrates were depleted faster than lignin in the alder and poplar, cellulose usually faster than the major hemicellulose (xylan). Lignin, which was analyzed by the "sulfuric acid" method, was depleted by all the fungi. Pine was decayed significantly by three of the fungi, and only to low weight losses (15 percent or less) by the other three (*Paecilomyces* sp., *Papulospora* sp., and *Thielavia terrestris)*. Analysis of blocks that were decayed showed that lignin was depleted faster than the cellulose or the hemicelluloses by *Paecilomyces* sp. and *Allescheria* sp.
KEYW Wood decay, thermophilic fungi, chemical composition wood, soft-rot fungi.

135 AUTH Evenden, J. C.
DATE 1921
TITL Forest insect control—need for careful surveillance of white pine stands of Idaho and Montana.
PUBL District 1 Applied Forestry Note 11. Missoula, MT: U.S. Department of Agriculture, Forest Service. 3 p.
ABST Mountain pine beetle started to increase on the Coeur d'Alene National Forest in 1919. This note stresses the need for insect surveys to detect extent of damage of mountain pine beetle and western pine beetle and methods for conducting surveys.
KEYW Mountain pine beetle, western pine beetle, insect survey.

136 AUTH Evenden, J. C.
DATE 1930
TITL Economic status of forest insects in the Northern Intermountain Region.
PUBL Northwest Science. 4: 51-54.
ABST Notes that mountain pine beetle in western white pine in northern Idaho had been steadily increasing. Except for the Coeur d'Alene Forest, control measures were considered inadvisable because of the magnitude of the infestation.
KEYW Mountain pine beetle, insects.

137 AUTH Evenden, J. C.
DATE 1930
TITL Insects and forest protection.
PUBL Idaho Forester. 12: 14-15, 61.
ABST Gives a summary of current philosophy (as of 1930) concerning insects and forest protection, lists many of the common forest insect problems, and emphasizes need for more consideration of the insect problem by foresters and the public in general. White pine is mentioned as one of the species demanding more attention from the protection standpoint.
KEYW Insects, western pine beetle.

138 AUTH Evenden, J. C.
DATE 1935
TITL A forest insect problem.
PUBL Idaho Forester. 17: 12-13.
ABST The author advocates artificial control to restore proper biological adjustment and use of silvicultural practices for long term control of the mountain pine beetle in western white pine.
KEYW *Dendroctonus ponderosae,* insects, silvicultural control (insects), resistance (insects), *Armillaria mellea*, parasites.

139 AUTH Evenden, J. C., Bedard, W. D., Struble, G. R.
DATE 1943
TITL The mountain pine beetle, an important enemy of western pines.
PUBL Circular 664. Washington, DC: U.S. Department of Agriculture, Forest Service. 25 p.

ABST From 1930 to 1939, the annual loss of merchantable white pine as a result of mountain pine beetle activity in Idaho and Montana amounted to 91 million bd ft. The successful management of white pine forests requires consideration of the important role played by the mountain pine beetle. As insect-killed white pine are seldom replaced by the same species, this change in timber type leaves a forest of different composition, usually of an inferior species, requiring a reorganization of management plans. Suggested control in white pine was peeling, decking, and burning infested trees.

KEYW Mountain pine beetle.

140 AUTH Fahnestock, G. R.
DATE 1953
TITL Chipping takes the hazard out of logging slash.
PUBL Research Note 125. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST The effectiveness of chipping on the inflammability of logging slash was tested in an experimental burning program at Priest River Experimental Forest, ID, in 1952. A portable chipper mounted on a two-wheel trailer was used. Green slash put through the machine and allowed to dry for over 2 months could scarcely be burned. Fire behavior in the chipped slash closely resembled that in natural litter and duff. Species appeared to be the strongest factor affecting rate of spread. The pines produced the hottest, fastest fires.
KEYW Chipping slash, inflammability of logging slash.

141 AUTH Fahnestock, G. R.
DATE 1953
TITL Inflammability of the current year's logging slash.
PUBL Research Note 124. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 10 p.
ABST Results of the study appeared not to be in accord with the commonly held opinion, based on experience, that certain species of slash produce a much more serious fire hazard than others. Western redcedar was most frequently listed as the most dangerous species from the slash standpoint. During the 1952 experimental burning program, however, cedar exhibited no particularly explosive characteristics and was really below average in rate of spread. Western white pine exhibited the most violent burning activity. Observers formed the impression that fires spread fastest in white pine slash, but analysis failed to demonstrate any significant difference due to species. Even hemlock proved to be as inflammable as cedar, pound for pound, when present in sufficient quantity to offset the absence of needles.
KEYW Inflammability of logging slash.

142 AUTH Fahnestock, G. R.
DATE 1953
TITL Relative humidity and fire behavior in logging slash.
PUBL Research Note 126. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Plots containing different amounts of slash per acre were burned when relative humidity was increasing rapidly. Comparison of rate of spread with current relative humidity showed that high humidities greatly reduced rate of spread in light and medium slash concentrations but had no significant effect on fires in heavy concentration. Average rate of spread is given by species tested, including western white pine.
KEYW Fire behavior.

143 AUTH Fahnestock, G. R., Dieterich, J. H.
DATE 1962
TITL Logging slash flammability after 5 years.
PUBL Research Paper INT-70. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 15 p.
ABST During the 5 years after it was cut and placed on sample plots, slash of nine Northern Rocky Mountain tree species changed greatly in appearance and flammability. Western white pine, lodgepole pine, western redcedar, and western hemlock still retained relatively large amounts of fine slash components well above the ground; experimental burning showed that flammability was still high. Grand fir and western larch had deteriorated most, and they exhibited very low flammability. Douglas-fir, ponderosa pine, and Engelmann spruce were intermediate.
KEYW Slash, flammability of logging slash, fire spread.

144 AUTH Faller, A., Jackson, M. T.
DATE 1968
TITL Vegetation gradients on Wizard Island, a volcanic cinder cone in Crater Lake, Oregon.
PUBL In: Proceedings Indiana Academy of Science. 77: 183. Abstract.
ABST Wizard Island, which covers about one-half square mile, is a volcanic cone extending about 760 feet above the present level of

Crater Lake. Eighty species of vascular plants are known to occur on the island, including 17 new species reported in this study. Forest associations include a rather dense *Tsuga mertensiana-Abies magnifica* var. *shastensis-Pinus monticola* forest which encircles the base of the cone.

KEYW Vegetation gradients, Crater Lake, Oregon, vegetation distribution, forest associations.

145 AUTH Farquhar, H. H.
DATE 1912
TITL Seed collection on a large scale.
PUBL In: Yearbook of Agriculture; Washington, DC: U.S. Department of Agriculture. p. 435-442.
ABST This article emphasized the need for large quantities of forest seed to replenish burned-over or cutover areas. A large seed collecting campaign for western white pine on the Kaniksu National Forest, ID, was described.
KEYW Seed collection, cone crop prediction, reforestation.

146 AUTH Fellin, D. G., Kennedy, P. C.
DATE 1972
TITL Abundance of arthropods inhabiting duff and soil after prescribed burning of forest clearcuts in northern Idaho.
PUBL Research Note INT-162. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST Abundance of some arthropods inhabiting the duff and soil on three clearcut areas that were prescribed burned was investigated in north-central Idaho. Generally more arthropods were present and more taxa were represented on older burns. In duff samples, the Acarina, Chilopoda, Thysanoptera, Protura, and Thysanuara were most numerous in more recent burns. Acarina comprised 77 percent of the fauna in the duff samples. Soil samples collected before mid-July contained about 90 percent of the total number of individuals—mostly immatures—especially on the oldest burn. The most abundant arthropod in the soil samples on the oldest burn was the carabid *Amara arratica*. Because of the abundance of this carabid and its seed-eating behavior, it is recommended that direct seeding of western white pine, and perhaps of other conifers, be done the first or second season after prescribed burning.
KEYW Arthropods, duff, soil, prescribed burning, direct seeding, *Amara arratica,* Carabidae.

147 AUTH Ferre, Y. D.
DATE 1962
TITL Brachyblastes a normaux chez *Pinus monticola.*
PUBL Bulletin of the Society of Natural History of Toulouse. 97: 373-388.
ABST Describes a batch of seedlings in which the normal 5-needle fascicles were rare, 4- or 10-needle fascicles occurred occasionally, and 6-, 7-, 8-, or 9-needle fascicles often.
KEYW Brachyblastes, short shoot.

148 AUTH Ferrell, W. K.
DATE 1955
TITL The relationship of pole blight of western white pine to edaphic and other site factors.
PUBL Research Note 13. Moscow, ID: University of Idaho, Forestry Wildlife and Range Experiment Station. 7 p.
ABST The aim of this study was to determine the range of topographic and edaphic conditions over which pole blight might occur and to compare it with the range of conditions in healthy pole stands of western white pine. While some soils or sites may be more conducive to the pole blight condition than others, the hypothesis that soil or site characteristics may directly cause this condition is not substantiated.
KEYW Pole blight, soils.

149 AUTH Ferrell, W. K., Hubert, E. E.
DATE 1952
TITL The use of radioisotopes in forest tree research.
PUBL Idaho Forester. 34: 42-45.
ABST This article is a synopsis of the current (1952) uses being made of radioisotopes in forest research. Three different types of tracer studies involving pole-blighted western white pine are presented as examples.
KEYW Radioisotopes, tracer studies, mycorrhizal fungi, pole blight.

150 AUTH Ferrell, W. K., Johnson, F. D.
DATE 1954
TITL A study of the absorption and translocation of mineral elements in diseased and healthy western white pines by the use of radioactive materials.
PUBL Progress Report, Atomic Energy Commission Contract No. AT (45-1)-373. 28 p.
ABST Distribution patterns for Ca and P were determined using radioisotopes of these two elements. The patterns of accumulation were compared among healthy western white pine, pole-blighted trees, and trees infected with *Armillaria mellea* or *Fomes pini.* Seedlings, pole-sized, and large trees were studied. Accumulation data are pictured graphically.

KEYW Radioisotope translocation, pole blight, *Armillaria mellea, Fomes pini.*

151 AUTH Ferrell, W. K., Johnson, F. D.
DATE 1956
TITL Mobility of Calcium-45 after infection in western white pine.
PUBL Science. 124: 364-365.
ABST Calcium-45 was used to study the mobility of calcium in western white pine. Results indicate there was a substantial movement of previously deposited calcium into newly developed buds.
KEYW Calcium-45, translocation.

152 AUTH Ferrell, W. K., Johnson, F. D., Michelsen, C. E.
DATE 1960
TITL Movement and distribution of radio-phosphorus in crowns of healthy and pole-blighted western white pines (*Pinus monticola* D. Don.)
PUBL Plant Physiology. 35: 413-417.
ABST Field experiments were performed to determine the distribution of phosphorus 32 after injection into pole-sized trees in healthy and in pole-blighted condition. On the basis of activity per gram of leaf tissue, accumulations were largest in the upper crowns of the healthy trees and in the lower crowns of the pole-blighted trees. Calculations on a specific activity basis gave no significant difference from the calculations of activity per gram of leaf tissue. Taking the tree as a whole, the rate of phosphorus 32 movement was considerably faster in the pole-blighted than in the healthy trees. When the extreme tops were severed, however, the rate in the severed tops was more rapid in the healthy than in the pole-blighted trees.
KEYW Radioisotopes, pole blight, translocation, radio-phosphorus.

153 AUTH Ferrell, W. K., Olson, D. S.
DATE 1952
TITL Preliminary studies on the effect of fire on forest soils in the western white pine region of Idaho.
PUBL Research Note 4. Moscow, ID: University of Idaho, Forestry Wildlife and Range Experiment Station. 7 p.
ABST The organic layer is shallow in western white pine forests because equilibrium between the rates of annual needle cast and decomposition is reached at a relatively early stage. Even so, when fires overrun the forest floor a large volume of organic matter with some plant nutrients is destroyed. In the majority of cases studied burning had little effect on the rate of water entry into the soil. Significant erosion was found on only one area studied; this was the development of 1/8-inch to 3/16-inch pedestals from rain drop action on a severely burned site. Chemical analyses of the soil samples showed pH values consistently higher on the burned than the unburned soils. Nitrogen percentages were higher on burned soils in six cases and lower in three. Available phosphorus was higher in five cases on burned soils and lower in three.
KEYW Soils, fire soils.

154 AUTH Filler, M. C., Hofstrand, A. D., Howe, J. P.
DATE 1964
TITL Laminated beam design for four western softwoods.
PUBL Forest Products Journal. 14: 451-455.
ABST Based on theoretical calculations and tests of a limited number of laminated beams, it appeared that recommended design stresses could be justified using a proportion of low-grade boards in the beams. Values of modulus of elasticity were higher than established values for the species tested. The difference in average moduli of elasticity between scarfed and nonscarfed latch beams was not significant. Scarfed beams appeared to have a lower moduli of rupture than nonscarfed beams. However, strength of scarfed beams when converted to working stresses was above fiber stress design limits.
KEYW Laminated beams, static bending tests.

155 AUTH Finch, T. L.
DATE 1948
TITL Effect of bark growth in measurement of periodic growth of individual trees.
PUBL Research Note 60. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The formula for western white pine is given as: $a = A - 2.075\,g$, when a = d.b.h. (o.b.) n years ago; A = current d.b.h. (o.b.); $g = n$ years radial growth, not including bark. The equation was based on 126 western white pine trees.
KEYW Bark growth.

156 AUTH Fisher, G. M.
DATE 1935
TITL Comparative germination of tree species on various kinds of surface-soil material in the western white pine type.
PUBL Ecology. 16: 606-611.
ABST Standard greenhouse tests were made with all the principal tree species of the western white pine type on surface-soil materials typical for the area. The results show only the comparative germination of each species

tested on the kinds of soil material used. Data are given for germination percentages within 100 days of seed sown, by surface-soil material and species, and viability of seed cut, by species; surface-soil materials most and least favorable to germination, germination percentages within 100 days for these materials, and viability percentages, by species; ratings of surface-soil materials as germination media.

KEYW Seed germination.

157 AUTH Fitzgerald, O. A.
DATE 1949
TITL Pole blight kills pines.
PUBL The Spokesman Review. 1949 July 31; Sunday Supplement 8-9.
ABST A newspaper account of the investigations being conducted to determine the causes of pole blight in western white pine.
KEYW Pole blight.

158 AUTH Fitzgerald, O. A.
DATE 1951
TITL Idaho's pole blight clinic.
PUBL American Forests. 57(10): 30-31, 38, 40.
ABST Written for lay readers, this article summarizes current (1951) research and knowledge concerning pole blight.
KEYW Pole blight.

159 AUTH Fitzgerald, O. A.
DATE 1951
TITL Plague in the big pines.
PUBL Popular Mechanics. 95(4): 140-142, 242, 246.
ABST This article, written in a popular style, gives an overall description of the pole blight problem and current research on the disease.
KEYW Pole blight.

160 AUTH Fitzwater, J. A.
DATE 1924
TITL A management plan for the Priest River Working Circle.
PUBL Idaho Forester. 6: 9-11, 62.
ABST Management practices in a working circle within the Kaniksu National Forest are presented. Volume by forest type, age class distribution, fire history, and the causes of fire are given.
KEYW Management, working circle, fire, mountain pine beetle, age class, volume.

161 AUTH Flint, H. R.
DATE 1925
TITL Fire resistance of Northern Rocky Mountain conifers.
PUBL Idaho Forester. 7: 7-10, 41-43.
ABST Inherent characteristics that influence fire resistance are (1) thickness of bark, (2) root habit, (3) resin content of bark, (4) branching habit, (5) stand habit, (6) relative inflammability of foliage, and (7) lichen growth. *Pinus monticola* appears about midway on a chart showing relative fire resistance of important Northern Rocky Mountain conifers.
KEYW Fire resistance.

162 AUTH Fobes, E. W.
DATE 1959
TITL Yield and value of finished lumber from western white pine trees and logs.
PUBL Report FPL-2163. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 32 p.
ABST This report presents data and an analysis of a cooperatively conducted survey of western white pine timber harvested from the Clearwater National Forest in northern Idaho. The 160 trees harvested produced 1,121 logs, 943 of which were sawn. Based on the scale record, only 132 of the trees were one-third or more merchantable. Excluding logs from nonmerchantable trees and cull logs from merchantable trees, 840 logs of merchantable quality were produced.
KEYW Diameter, length, scale results, volume, board-foot volume, grading, size-class, tree breakage.

163 AUTH Foiles, M. W.
DATE 1951
TITL Results of seeding germinated western white pine seed.
PUBL Research Note 95. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Recommended methods of direct-seeding western white pine call for planting in the fall following the control of seed-eating rodents by poisoning. Spring-sowing of germinated seed was tested on four plots as a method of eliminating direct rodent control in order to reduce the cost of direct seeding. This test showed that initial stocking from spot-sown germinated seed was no better than from seed that had been stratified but not germinated. On the other hand, protecting the seed spots from rodents with conical wire screens resulted in significantly greater initial stocking. Therefore, spring-seeding germinated western white pine seed did not eliminate the necessity for rodent control.
KEYW Direct seeding, fall sowing, spring sowing.

164 AUTH Foiles, M. W.
DATE 1951
TITL Test of seeding germinated western white pine seed.
PUBL Tree Planters' Notes. 8: 10-11.

ABST No increase in stocking resulted from sowing germinated seed. Stocking was the same for germinated and ungerminated seeds—46 percent filled spots for both treatments.
KEYW Direct seeding.

165 AUTH Foiles, M. W.
DATE 1955
TITL Thinning from below in a 60-year-old western white pine stand.
PUBL Research Note INT-19. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Results from a test of thinning a 60-year-old western white pine stand indicated that thinning does not appreciably change total volume growth, but it does improve the quality of the final product by increasing diameter growth and improving stand composition.
KEYW Thinning, volume growth, diameter growth, stand composition.

166 AUTH Foiles, M. W.
DATE 1956
TITL Effects of thinning a 55-year-old western white pine stand.
PUBL Journal of Forestry. 54: 130-132.
ABST The thinnings had little effect on total volume production but enhanced the value of the stand by increasing the proportion of high value white pine in it. They stimulated diameter growth of dominant and codominant stems but not at a rate that resulted in an appreciably greater number of larger diameter trees than on the check plot.
KEYW Thinning, volume per acre, diameter growth.

167 AUTH Foiles, M. W.
DATE 1959
TITL Silvics of grand fir.
PUBL Miscellaneous Publication 21. Washington, DC: U.S. Department of Agriculture, Forest Service. 12 p.
ABST The climatic, edaphic, and physiographic requirements of grand fir and associated species (including western white pine) are described.
KEYW Climate, associated species.

168 AUTH Foiles, M. W.
DATE 1961
TITL Effects of thinning seed spots on growth of three conifers in the Inland Empire.
PUBL Journal of Forestry. 59: 501-503.
ABST Direct sowing of ponderosa pine, western white pine, and Engelmann spruce seeds in small prepared spots resulted in establishment of several seedlings in each spot. Some spots were artificially thinned to test the effects of seed-spot density on the growth of each of these species in northern Idaho and northeastern Washington. Results of this experiment show that the number of seedlings per spot significantly affected diameter growth of 17-year-old trees of all three species. Diameter growth of the dominant seedlings decreased as the number of seedlings per spot increased. A decrease in height growth of western white pine on densely stocked spots was significant in one test but not in the other. Thinning seed spots is not recommended, for a satisfactory stand will develop without it.
KEYW Seed spot thinning, direct seeding.

169 AUTH Foiles, M. W.
DATE 1965
TITL Time required to prune crop trees in the western white pine type.
PUBL Research Note INT-32. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST This test was designed to provide estimates of the time required to prune white pine crop trees to a height of 18 feet. The following factors influence labor time: density of stocking and brush cover; number, size, and condition of branches; topography; height of pruning; tree species; crew training, experience, and supervision. Data show that with average stand conditions approximately 37 trees can be pruned per person-day, but that a combination of the factors listed above can reduce the person-day production to as low as 16 trees.
KEYW Pruning.

170 AUTH Foiles, M. W.
DATE 1972
TITL Responses in a western white pine stand to commercial thinning methods.
PUBL Research Note INT-159. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST Effects of crown and selection thinning at two levels (20 percent and 35 percent volume removed) and of no thinning were compared in an 87-year-old mixed conifer stand dominated by western white pine and grand fir. The 35-percent crown thinning produced the best diameter growth response and resulted in least mortality during the 10 years following treatment. Net annual volume growth per acre was highest on the control plots (837 bd ft), but was nearly as

high for light-crown thinning (776 bd ft). Light selection thinning was almost as effective as the crown thinnings, but 35 percent selection thinning resulted in excessive mortality and reduced net volume growth.

KEYW Stand conditions, thinning.

171 AUTH Foote, P. A., Mirov, N. T.
DATE 1933
TITL A phytochemical investigation of the oleoresin of *Pinus monticola* Dougl.
PUBL Journal of the American Pharmacy Association. 22: 825-834.
ABST The oleoresin of *Pinus monticola,* obtained from trees growing under unfavorable conditions in the Warner Mountains of California, has been investigated. The environment of the trees is described. Details of the oleoresin extraction are given, supplemented by tables of yield for oleoresin, oil, and resin. The properties of each are described. The oil contains d-alpha-pinene, 60 percent; beta-pinene, 26 percent; n-undecane, 1-2 percent; and sesquiterpenes. Limonene is perhaps present.
KEYW Oleoresin.

172 AUTH Foster, R. E.
DATE 1957
TITL Pole blight of western white pine.
PUBL Ottawa: Canadian Department of Agriculture, Forest Biology Division, Science Service. 5 p.
ABST This report outlines the history of the disease and investigations carried out by the forest biology laboratory. Data include mortality in the vertical and lateral root systems of western white pine, and progress of pole blight on experimental plots in the Silverton area, BC. The authors recommend that if the percentage of affected pine is sufficient to warrant salvage, all pine of merchantable size, healthy and affected, should be harvested, as a partial cut would fail to provide adequate protection to the residual stand.
KEYW Pole blight, cambial lesions, leader growth, roots, root mortality.

173 AUTH Fowler, M. E.
DATE 1950
TITL Airplane scouting for pole blight of western white pine.
PUBL Journal of Forestry. 48: 23.
ABST Summarizes techniques and methods of an aerial survey for pole blight conducted in 1949 on the St. Joe and Clearwater National Forests. Ground checks were necessary to distinguish pole blight from conditions such as logging injury, sunscald, or unusual retention of old yellowed needles.
KEYW Pole blight, aerial survey.

174 AUTH Fowler, M. E.
DATE 1952
TITL Aircraft scouting for pole blight and oak wilt.
PUBL Journal of Forestry. 50: 191-195.
ABST This article summarizes results of aerial surveys made in 1949, 1950, and 1951.
KEYW Pole blight, aerial survey.

175 AUTH Fowler, M. E.
DATE 1952
TITL Information sought on distribution of white pine pole blight.
PUBL Journal of Forestry. 50: 1.
ABST Requests information on suspected pole blight on the Pacific Coast.
KEYW Pole blight.

176 AUTH Fowler, M. E.
DATE 1954
TITL Pole blight.
PUBL American Forests. 54(20): 48.
ABST Gives the symptoms of the pole blight disease and indicates that aerial surveys can give accurate estimates of the extent of the disease.
KEYW Pole blight, aerial survey.

177 AUTH Franklin, J. F.
DATE 1965
TITL Tentative ecological provinces within the true fir-hemlock forest areas of the Pacific Northwest.
PUBL Research Paper PNW-22. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 31 p.
ABST This paper suggests useful geographic divisions of the true fir-hemlock forests of western Oregon and Washington. Western white pine is listed as a major species in Mount Adams, Mount Hood, Three Sisters, Crater Lake, Wenatchee, and Siskiyou provinces and as a minor species in Mount Baker, Mount Rainier, Willamette, and Olympic provinces.
KEYW Ecological province, western Washington, western Oregon, true fir-hemlock forests.

178 AUTH Franklin, J. F.
DATE 1968
TITL Cone production by upper-slope conifers.
PUBL Research Paper PNW-60. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 21 p.
ABST This paper is a progress report on cone-bearing habits of seven upper-slope tree species in the Pacific Northwest. Nine plots of the 47 were of western white pine. Western white pine was a consistent cone

producer and showed a general pattern of cone periodicity.
KEYW Cone production, cone periodicity, Pacific Northwest.

179 AUTH Franklin, J. F., Carkin, R., Booth, J.
DATE 1974
TITL Seeding habits of upper-slope tree species; (1) a 12-year record of cone production.
PUBL Research Paper PNW-213. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 12 p.
ABST A 12-year study of cone production by noble, Pacific silver, grand, white, subalpine, and Shasta red firs, mountain hemlock, western white pine, and Engelmann spruce showed that upper-slope species produce medium to heavy crops at 2- to 3-year intervals at most locations. The 1968 cone crop was the heaviest observed to date.
KEYW Cone counting, cone production, cone crop intervals.

180 AUTH Franklin, J. F., Dyrness, C. T.
DATE 1973
TITL Natural vegetation of Oregon and Washington.
PUBL General Technical Report PNW-8. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 417 p.
ABST Descriptions of each vegetation zone include composition and succession as well as discussion of variations associated with environmental gradients.
KEYW Vegetation, plant communities, habitat types, plant succession, soils.

181 AUTH Franklin, J. F., Hoffman, J.
DATE 1968
TITL Two tests of white pine, true fir, and Douglas-fir seed spotting in the Cascade range.
PUBL Research Note PNW-80. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 11 p.
ABST Satisfactory stocking was obtained on seed spots protected from rodents by wire screens but generally not on unscreened spots despite extensive baiting of study areas. Western white pine was the most successful species used and true firs were least successful. Damping-off, rodents, and insects were responsible for most seedling mortality.
KEYW Clearcuts, seed germination, survival, direct seeding, rodents.

182 AUTH Funk, A.
DATE 1964
TITL Extensions of the host ranges and distribution of *Caliciopsis* species on western conifers.
PUBL Plant Disease Reporter. 48: 677.
ABST The host ranges of species of *Caliciopsis* that attack conifers growing in western North America were reported in 1963. Through artificial inoculations, *Caliciopsis pinea* was shown to attack western white pine vigorously while inoculations on Douglas-fir were negative. Further observations on host range, occurrence, and pathogenicity are reported here.
KEYW *Caliciopsis pinea*, artificial inoculation.

183 AUTH Furniss, R. L., Carolin, V. M.
DATE 1977
TITL Western forest insects.
PUBL Miscellaneous Publication 1339. Washington, DC: U.S. Department of Agriculture, Forest Service. 603 p.
ABST Biological aspects of western North American Forest insects are described. Contains a diagnostic host index as well as a general index.
KEYW Western insects, insects.

184 AUTH Garrett, P. W.
DATE 1970
TITL Early evidence of weevil resistance in some clones and hybrids of white pine.
PUBL Research Note NE-117. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.
ABST White pine species and hybrids were being tested for inherent resistance to the white pine weevil. First-year results offered hopes of finding or developing resistance in this group. *Pinus monticola* had a low level of weeviling, while the hybrid *P. strobus* x *P. wallichiana* was heavily weeviled.
KEYW *Pissodes strobi,* weevil resistance, clones, hybrids.

185 AUTH Genys, J. B.
DATE 1963
TITL Summary of forest tree improvement work in Maryland by the Natural Resources Institute, University of Maryland.
PUBL Annapolis, MD: University of Maryland, Natural Resources Institute, Mimeograph Report 63-40. 7 p.
ABST In 1962-63, the Natural Resources Institute started an experiment with 156 provenances of white pines. This study included the most densely sampled eastern white pine; 20 seed samples of Himalayan white pine, the majority of which originated in Pakistan, India,

and Bhutan; and 11 provenances of western white pine.
KEYW Provenance test.

186 AUTH Genys, J. B.
DATE 1963
TITL Two-year growth differences in five white pine species, studied in Maryland.
PUBL Annapolis, MD: University of Maryland, Natural Resources Institute, Mimeograph Report 63-52. 4 p.
ABST In 1961 the Natural Resources Institute in cooperation with the Maryland Department of Forests and Parks initiated this research project to learn some facts about the performance of exotic white pines (series *Strobi*) in comparison to eastern white pine. Species involved were *P. strobus*, *P. monticoLa*, *P. griffithii*, *P. lambertiana*, and *P. ayacahuite*. Western white pine and Mexican white pine seedlings had most of the seed coats shed when the seed of Himalayan pine was still in the ground. Western white pine was the first one to form terminal buds in 1962, followed by Mexican white pine and sugar pine. Himalayan white pine continued the seasonal height growth the longest, as well as the southern sources of eastern white pine. Analysis of 2-year height growth showed three significantly different ranks of performance. Mexican white pine and sugar pine seedlings were very significantly larger than other seedlings tested. On the other extreme, two provenances of western white pine from Idaho were very distinctly smaller than others. The smallest seedlings in the experiment originated from a blister-rust-resistant western white pine in Idaho.
KEYW Provenance test.

187 AUTH Genys, J. B.
DATE 1964
TITL Report on establishment of tree seed orchards in Maryland with a special reference to white pines.
PUBL In: Proceedings, 12th northeastern forest tree improvement conference. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. p. 14-15.
ABST Seven provenances of western white pine were compared with provenances of *P. strobus, P. griffithii, P. sylvestris, P. virginiana,* and *P. glauca* as potted seedlings in a greenhouse. The slowest growing provenance of western white pine attained 66 percent of the height of the fastest growing provenance.
KEYW Seed orchards, Maryland, height growth, provenance test.

188 AUTH Genys, J. B.
DATE 1965
TITL Two-year growth differences in five white pine species studied in Maryland.
PUBL Journal of Forestry. 63: 126-128.
ABST Five white pine species (series *Strobi*) were tested in the Maryland Forest Nursery for comparison of performance. Eleven seed lots were sown in four randomized blocks. Two-year seedlings of sugar pine from Oregon, and apparent hybrids from a tree in Rochester, NY, listed as a Mexican white pine, showed significantly superior heights to those of all other species tested. Western white pine from Idaho (two sources) represented the other extreme, being considerably smaller. Five provenances of eastern white pine and two provenances of Himalayan white pine showed intermediate heights. Himalayan white pine germinated late and formed the first-year terminal buds the latest in the season. Western white, sugar, and Mexican white pine showed the opposite behavior.
KEYW Provenance test.

189 AUTH Gerhold, H. D.
DATE 1961
TITL Testing white pines for weevil resistance.
PUBL In: Proceedings, ninth northeastern forestry tree improvement conference; 1961 August 23-25; Syracuse, NY. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. p. 44-53.
ABST In this proposed plan for testing white pines for weevil resistance, *P. monticola* is considered to be one of the more promising sources of weevil resistance.
KEYW *Pissodes strobi*, weevil resistance.

190 AUTH Gibson, A. L.
DATE 1943
TITL Penetrating sprays to control the mountain pine beetle.
PUBL Journal of Economic Entomology. 36(3): 396-398.
ABST Several penetrating oil sprays were tested for effectiveness against the mountain pine beetle in lodgepole and whitebark pines. A mixture of diesel oil and orthodichlorobenzene proved to be the best compromise between low cost and control. Some advantages of penetrating spray use are mentioned.
KEYW *Dendroctonus ponderosae,* penetrating spray.

191 AUTH Gilbertson, R. L., Leaphart, C. D., Johnson, F. D.
DATE 1961

TITL Field identification of roots of conifers in the Inland Empire.
PUBL Forest Science. 7: 352-356.
ABST During the course of investigations of root systems of western white pine and its associated species in the Inland Empire, a key for field identification of the roots of 11 important coniferous species was developed. Species include *Abies grandis, A. lasiocarpa, Larix occidentalis, Picea engelmannii, Pinus albicaulis, P. contorta, P. monticola, P. ponderosa, Pseudotsuga menziesii, Thuja plicata,* and *Tsuga heterophylla.*
KEYW Root identification, root characteristics, field key roots.

192 AUTH Gill, L. S.
DATE 1948
TITL A preliminary report on mortality of western white pine in the Bear Paw Tract of the Kaniksu National Forest.
PUBL Typed manuscript dated October 8, 1948. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Sciences Laboratory, Moscow, ID.
ABST Mortality plots were established in a stand exhibiting mortality to an unclassified disease. Eventually it was identified as pole blight. All dead white pine were tallied by 2-inch diameter class. Mortality in the 10-inch class was about twice that of any other class.
KEYW Pole blight, mortality level.

193 AUTH Gill, L. S.
DATE 1949
TITL A review of the research and survey work on pole blight of western white pine by the Division of Forest Pathology.
PUBL Northwest Scientific Association Meeting Report; 1949 December 7; Albuquerque, NM. 3 p.
ABST The 1948 work was largely exploratory and not productive of definite conclusions. Studies on the stems and roots of several trees in pole blight areas suggested that a diseased condition of the root system is part of the pole blight complex, and the earliest symptoms of the disease may very well appear in the roots and could easily develop before pole blight is recognized in the crown. Of the organisms known to attack roots of western white pine, *Armillaria mellea* was the one most frequently isolated; the one fungus found to show definitive pathogenic tendencies under laboratory conditions was believed to be *Scopularia serpens.* A 100 percent tally on a 44-acre tract plot in the Bear Paw drainage of the Kaniksu National Forest showed that in 8 years, 10 percent of the merchantable trees had died from pole blight.
KEYW Pole blight, *Armillaria mellea.*

194 AUTH Gill, L. S., Andrews, S. R.
DATE 1949
TITL Note on a *Scopularia* attacking western white pine.
PUBL Plant Disease Reporter. 33: 227.
ABST While engaged in investigations of "pole blight," a disease of unknown cause, attacking western white pine in Idaho, Montana, and Washington, the writers had occasion to make several hundred isolations in an attempt to determine what fungi, if any, were involved. Among the fungi isolated were several members of the genus *Scopularia preussemend* (*Leptographium*). One of them resembled *S. serpens* more strongly than it did any species previously reported on western white pine from this region and was particularly noteworthy because preliminary tests indicate it may be parasitic on bark as well as wood. The fungus was isolated from stems and roots of diseased as well as apparently healthy trees at several widely scattered points throughout the range of *Pinus monticola.* Several isolates were used for inoculations in short pieces of pine stems on which they produced definite bark lesions in 5 to 8 days and often caused blue stain in the underlying wood within 3 weeks.
KEYW *Scopularia,* pole blight.

195 AUTH Gill, L. S., Andrews, S. R., Millenbaugh, R. E.
DATE 1949
TITL Pole blight investigations by Forest Pathology, 1948.
PUBL Unpublished Report 141. Albuquerque, NM: U.S. Department of Agriculture, Bureau of Plant Industry, Division of Forest Pathology. 22 p.
ABST This review of the work on pole blight for 1948 includes surveys, maps of pole blight locations, patterns of bark necrosis, tree descriptions, root system analyses, presence of root-rotting fungi, artificial inoculations with various isolates, damage studies, virus tests.
KEYW *Scopularia, Armillaria mellea, Cryptosporium, Atropellis, Cucurbicothis, Stigmella, Endobotryella, Penicillium, Trichoderma,* virus tests, pole blight, pole blight locations.

196 AUTH Gill, L. S., Leaphart, C. D., Andrews, S. R.
DATE 1951
TITL Preliminary results of inoculations with a species of *Leptographium* on western white pine.

PUBL Forest Pathology Special Release 35. Albuquerque, NM: U.S. Department of Agriculture, Bureau of Plant Industry, Division of Forest Pathology. 14 p.

ABST Preliminary inoculation tests indicated that a fungus similar to *Leptographium serpens* may be involved in the pole blight disease of western white pine. In 1949, inoculations of this and three other fungi (*Armillaria mellea*, *Scopularia,* and *Poria weirii*) were attempted in seven plots. Field examinations of the inoculations made during the summer of 1950 showed that, while no crown symptoms of pole blight were present on any of the plots, many of the *Leptographium* stem inoculations had resulted in heavy resinosis. Inspections of the root inoculations showed that *Leptographium* sp. was also active in most cases, whereas those made with the other fungi appeared to be negative.

KEYW Pole blight, *Leptographium, Scopularia, Armillaria mellea, Poria weirii,* inoculation.

197 AUTH Graham, D. P.
DATE 1955
TITL Distribution of pole blight of western white pine.
PUBL Research Note INT-15. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.

ABST Disease surveys conducted in 1953 and 1954 to determine the distribution of pole blight of western white pine revealed that most areas of damage had been found. The established range of the disease had not increased in the past 2 years except for some extension to the northeast on the Coeur d'Alene National Forest and the extensions east and northwest on the St. Joe National Forest. The acreage of western white pine affected by pole blight in the United States was estimated to be between 90,000 and 95,000 acres of moderate to severe damage.

KEYW Pole blight, disease survey.

198 AUTH Graham, D. P.
DATE 1958
TITL Results of pole blight damage surveys in the western white pine type.
PUBL Journal of Forestry. 56: 652-655.

ABST A sample-plot survey to determine the damage caused by the pole blight disease and its effect on the stand was made in the western white pine type. Stands sampled were distributed throughout the known range of the disease. Results of this survey confirmed that pole blight is a serious problem in the western white pine type. The past and current level of damage, as determined from the survey, has caused and is continuing to cause (1958) a serious reduction in productivity. Pole blight damage in many affected stands greatly exceeded growth and thus, under current conditions, will eliminate white pine as a commercially important species in these stands in a relatively short time.

KEYW Pole blight, pole blight survey.

199 AUTH Graham, D. P.
DATE 1958
TITL Results of some silvicultural tests in pole blight diseased white pine stands.
PUBL Journal of Forestry. 56(4): 284-287.

ABST Data are presented from two studies on the effects of cutting on pole blight of western white pine. Preliminary results indicated that thinning subsequent to the appearance of the disease and salvage cutting of affected areas does not reduce disease progress in the residual stand.

KEYW Pole blight, basal area, thinning, salvage cut, residual stand.

200 AUTH Graham, D. P.
DATE 1959
TITL Pole blight threatens western white pine.
PUBL Western Conservation Journal. 16: 16-17.

ABST The author indicated that the cause of pole blight was still unknown, but its effects were obvious: it kills pole-sized trees of one of our most valuable commercial tree species. Distribution surveys showed that nearly one-seventh of the acreage in white pine pole-sized stands was affected in 1959 and that about 50 percent of these trees were diseased or dead, representing a yearly loss of about 17 3/4 million cubic feet. Possible causes of pole blight are listed as infectious agents, nutritional deficiencies, soil conditions, and climatic factors. No effective control can be undertaken until the cause is determined.

KEYW Pole blight.

201 AUTH Graham, R. T.
DATE 1980
TITL White pine vigor—a new look.
PUBL Research Paper INT-254. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 15 p.

ABST Vigor classes for mature western white pine were used to estimate periodic annual diameter growth, but no differences in diameter growth rate could be detected between the excellent, good, and fair vigor classes. The diameter growth rate of the poor vigor class was different from the other classes. Using individual tree characteristics (crown ratio, crown class, and tip vigor), no better predic-

tion of diameter growth rate could be achieved.

KEYW Vigor classes, diameter growth, growth and mortality, stand condition, mortality condition.

202 AUTH Graham, R. T., Tonn, J. R.
DATE 1979
TITL Response of grand fir, western hemlock, western white pine, western larch, and Douglas-fir to nitrogen fertilizer in northern Idaho.
PUBL Research Note INT-270. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST Significant ($p < 0.05$) responses in diameter growth to fertilization were noted at one of the study areas. Significant differences were detected between the height growth means in both study areas. Differences between the height and diameter growth means for the 200 lb N per acre treatment and the 400 lb N per acre treatment were not significant. When each species was analyzed separately, only grand fir and Douglas-fir had a significant response to fertilizer application.
KEYW Fertilization, diameter growth, height growth.

203 AUTH Graham, R. T., Tonn, J. R.
DATE 1980
TITL Case study: growth and development of forest stands in the Northern Rocky Mountains.
PUBL Research Paper INT-255. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 24 p.
ABST Tree diameter and height growth were compared for nine habitat types. Ten-year diameter growth was highly variable among habitat types as was 10-year height growth. High variation in both diameter and height growth also occurred within habitat types. Thirty-six local yield tables are presented, one for each stand in the study.
KEYW Growth and habitat types, growth, yield tables.

204 AUTH Graham, R. T., Wellner, C. A., Ward, R.
DATE 1983
TITL Mixed conifers, western white pine, and western redcedar.
PUBL In: Burns, R. M., technical compiler. Silvicultural systems for the major forest types of the United States. Agriculture Handbook 445. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 67-69.
ABST Summarizes the size, climate, habitat, and associated species of cover types western white pine and western redcedar. Production potential, insect and disease problems, and management possibilities are also discussed.
KEYW Cover types, climate, associated species, management methods.

205 AUTH Grand, L. F.
DATE 1968
TITL Conifer associates and mycorrhizal syntheses of some Pacific Northwest *Suillus* species.
PUBL Forest Science. 14: 304-312.
ABST The relative frequency of occurrence of sporophores of various *Suillus* species, as determined in natural stands of certain conifers in northern Idaho, indicated possible mycorrhizal relationships among *S. granulatus*, *S. sibiricus*, and *S. tomentosus* vars. *discolor* and *tomentosus* with *Pinus monticola*, as well as other *Suillus* species with other northern Idaho conifers.
KEYW *Mycorrhiza*, *Suillus granulatus*, *Suillus sibiricus*, *Suillus tomentosus*.

206 AUTH Gravelle, P.
DATE 1977
TITL Growth response and logging damage to advanced regeneration following overstory removal: the present state of knowledge.
PUBL Forest Technical Paper TP-77-3. Lewiston, ID: Potlatch Corporation. 27 p.
ABST A review of current literature is presented on the growth release and damage effects of overstory removal cutting on advanced regeneration. Available information indicated that diameter growth can be expected to increase the first year after release from overstory competition. Height growth response may be delayed for 2 to 5 years, but will then increase 2 to 4 times the rate before overstory removal. Logging may disturb up to 30 percent of an area, but if done with care, will not seriously affect the future management of the advanced regeneration. Decay incidence in stem injuries of young trees should not become a problem if the wounds heal within 10 years. Recommended guidelines are presented to reduce logging damage and choose crop trees in precommercial thinnings following logging.
KEYW Growth response to light levels, logging damage.

207 AUTH Green, A. W., Alley, J. R.
DATE 1967
TITL Evaluating species alternatives for National Forest land capable of growing western white pine.

PUBL Research Paper INT-43. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 40 p.

ABST Economic evaluations of species alternatives for timber production on cutover lands on National Forests are necessary for efficient use of money in achieving basic management goals. The basic biological and economic considerations for such evaluations are discussed and a sample problem is presented. Two EDP investment analysis programs are listed with instructions for use in ranking alternative species and management programs.

KEYW Species alternatives.

208 AUTH Habeck, J. R.
DATE 1968
TITL Forest succession in the Glacier Park cedar-hemlock forests.
PUBL Ecology. 49: 872-880.
ABST A gradient analysis and description was made of forest succession among the *Thuja plicata-Tsuga heterophylla* communities in the vicinity of Lake McDonald in Glacier National Park, MT. Thirty-three pioneer, seral, and climax communities located on well-drained slopes at elevations between 3,200 and 3,500 ft were sampled. Through the calculation of indices of community similarity and dissimilarity, the stands were objectively arranged along a unidimensional gradient. The data summarized along the resulting ordination gradient provide a quantitative description of the basic successional pattern existing among these cedar-hemlock communities. Typically, following burning *Pinus contorta* communities become established, and these in turn are gradually replaced by *Pinus monticola* and *Pseudotsuga menziesii* in various proportions. Climax communities on the upland sites become dominated by *Tsuga heterophylla*, with smaller, but self-reproducing populations of *Thuja plicata* also persisting.
KEYW Forest succession, Glacier Park.

209 AUTH Haig, I. T.
DATE 1924
TITL Accelerated growth after cutting in western white pine.
PUBL District 1 Applied Forestry Note 55. Missoula, MT: U.S. Department of Agriculture, Forest Service. 5 p.
ABST This preliminary study seems to warrant the conclusion that western white pine makes accelerated growth after partial cutting. The response appears to be relatively greater in the smaller trees and those of lower crown class than in the larger trees. Response is markedly less in trees that are slightly lacking in health and vigor. In general, western white pine appears to be much less aggressive in responding to stimulation than western yellow pine. Acceleration begins usually 2 years after cutting and shows no sign of slowing up at 15 years, the oldest area studied.
KEYW Partial cutting, diameter growth, volume crown class.

210 AUTH Haig, I. T.
DATE 1924
TITL The application of normal yield tables.
PUBL Journal of Forestry. 22: 902-906.
ABST Discusses the application of normal yield tables being prepared at Priest River Experimental Forest for the western white pine type. A study is under way to determine a correction factor that will permit application of normal yield tables to actual stands.
KEYW Yield tables, normal yield, correction factor growth.

211 AUTH Haig, I. T.
DATE 1925
TITL The effect of slash disposal on subsequent reproduction.
PUBL District 1 Applied Forestry Note 60. Missoula, MT: U.S. Department of Agriculture, Forest Service. 3 p.
ABST Data for seven species showed that slash left after logging exerts a noticeable influence in reducing the amount of reproduction in the western white pine type. Therefore, slash removal, though primarily a fire protection measure, is an excellent silvicultural measure as well.
KEYW Slash disposal, reproduction, regeneration, seedlings per acre.

212 AUTH Haig, I. T.
DATE 1925
TITL Shortcuts in measuring tree heights.
PUBL Journal of Forestry. 23: 941-944.
ABST The paper describes a simple circular slide rule designed to allow measurement of slope distance and field computation of heights.
KEYW Tree height measurements, slide rule.

213 AUTH Haig, I. T.
DATE 1930
TITL A quarter century of silviculture in the western white pine type.
PUBL Forestry Kaimin. Missoula, MT: University of Montana. p. 36-41, 72-76.
ABST The first National Forest timber sale was made in 1907. Methods for reforestation for white pine were unknown. From 1900 to

1930 methods made a complete circle from seed tree, clearcuts with seed blocks, clearcuts with seed strips, clearcuts with seed groups, back again to scattered seed trees.

KEYW Seed trees windblown, clearcuts, seed trees in blocks, shelterwood cut, clearcut strips, seed storage in duff.

214 AUTH Haig, I. T.
DATE 1931
TITL Stand tables for second-growth western white pine.
PUBL Northwest Science. 5: 94-98.
ABST Contains yield tables for second-growth western white pine, the first ever published. Tables are for fully stocked stands of average composition.
KEYW Stand tables, second growth, diameter class, yield tables.

215 AUTH Haig, I. T.
DATE 1931
TITL The stocked-quadrat method of sampling reproduction stands.
PUBL Journal of Forestry. 29: 747-749.
ABST The stocked-quadrat method is based on the assumption that if a given area is divided into squares of such a size that one established seedling or tree per square will fully stock the square at maturity, then the percentage of units so stocked indicates the proportion of land being utilized by tree growth. A 4-milacre or 3.2-ft^2 unit was adopted for western white pine.
KEYW Stocked-quadrat method, reproduction.

216 AUTH Haig, I. T.
DATE 1932
TITL Comparative timber-yields.
PUBL Journal of Forestry. 30: 575-578.
ABST The author compares the maximum average annual growth of 15 coniferous species. Western white pine ranks ninth in cubic foot growth and fifth in board foot growth. However, it ranks 14th based on relative growth rate based on time for tree to reach 8 inches d.b.h.
KEYW Timber yield, growth rate, maximum annual growth, species comparisons.

217 AUTH Haig, I. T.
DATE 1932
TITL Premature germination of forest tree seed during natural storage in duff.
PUBL Ecology. 13: 311-312.
ABST About one-third of the viable seed stored in the duff germinated during the second season, less than 1 percent the first season.
KEYW Seed germination, seed storage in duff.

218 AUTH Haig, I. T.
DATE 1932
TITL Second-growth yield, stand, and volume tables for the western white pine type.
PUBL Technical Bulletin 323. Washington, DC: U.S. Department of Agriculture, Forest Service. 67 p.
ABST The purpose of this bulletin was to sum up for forest managers and timberland owners the available information on the growth and yield of second-growth western white pine stands. The yield tables give the number of trees, the average size of tree, the rate of growth, and the quantity of wood per acre at different ages and qualities of site for even-aged, fully stocked western white pine stands. The resulting yield tables are applicable to western white pine stands throughout the entire region; they are also applicable to any stand containing 15 percent or more of western white pine.
KEYW Diameter breast height, basal area, age, even aged stands, stocking, composition, dominant, site quality, site index, mean annual increment, periodic annual increment, utilization standards, yield.

219 AUTH Haig, I. T.
DATE 1933
TITL Treatment of understory hemlock in the western white pine type.
PUBL Journal of Forestry. 31: 578-583.
ABST The author recommended the following treatment of hemlock understory stands containing a large percentage of vigorous trees with pointed crowns: (1) Retain the hemlock understory if it is sound. (2) Slash the hemlock understory if it is defective; that is, if over 40 percent of the trees are defective at the time of original logging.
KEYW Understory, stand composition, predicted yield, stumpage value.

220 AUTH Haig, I. T.
DATE 1936
TITL Factors controlling initial establishment of western white pine and associated species.
PUBL Bulletin 41. New Haven, CT: Yale University. School of Forestry. 149 p.
ABST Seedling losses were studied by means of small sown plots scattered over the habitat areas, the surface layers of which were of natural mineral soil, burnt mineral soil, and duff. Conclusions: the direct agents are rodents, soil fungi, soil insects (cutworms), surface soil temperature and soil moisture. Damping off is the most important biotic factor and insolation and drought the most important physical factors. Light is not a direct factor in initial mortality.

KEYW Seedling mortality, root penetration, insolation.

221 AUTH Haig, I. T.
DATE 1939
TITL Accuracy of quadrat sampling in studying forest reproduction on cut-over areas.
PUBL Ecology. 10: 374-381.
ABST This paper discusses the accuracy of quadrat sampling as applied to reproduction studies in the western white pine type, and discusses methods by which this accuracy can be measured. In general, the methods used in this study consisted of counting reproduction on milacre (6.6-ft^2) quadrats distributed at $^1/_2$- or 1-chain (33- or 66-ft) intervals along parallel strips 2.5 to 10 chains apart. This quadrat-at-interval system, giving a sample of from 0.1 to 0.8 percent of total area, was found to give satisfactory values for both frequency index (percentage of area stocked) and average number of seedlings per acre. In checking the values for average number of seedlings per acre, a method is suggested by which the j-shaped frequency distributions, probably common in similar ecological and silvical studies, can be converted into more nearly normal distributions and so strengthened as to permit the application of the probable error concept with a reasonable degree of safety. Indications are given that in sampling by the quadrat-at-interval method it is essential to have the parallel strips well distributed over the area, and that when only a limited sample can be taken, the tendency should be to lengthen the interval between quadrats rather than the distance between strips.
KEYW Quadrat sampling, reproduction, reforestation.

222 AUTH Haig, I. T., Davis, K. P., Weidman, R. H.
DATE 1941
TITL Natural regeneration in the western white pine type.
PUBL Technical Bulletin 767. Washington, DC: U.S. Department of Agriculture, Forest Service. 99 p.
ABST This bulletin brings together the available information on natural regeneration of the western white pine type, based on about 25 years of forest research and 30 years of National Forest timber cutting experience. Information included: geographic distribution of western white pine; history of early investigations and practices; species composition of timber stands; age distribution of different species; climatic factors affecting regeneration including precipitation, snowfall, growing season, temperature; susceptibility to injury including relative fire resistance of individual species, disease considerations (white pine blister rust and other forest tree diseases), insects, snow, and wind; seed supply, including effect of fire on seed maturation, kind and number of seed trees needed, and seed production of associated species; dissemination including distance, storage, losses, source of seed; germination; seedling establishment including losses due to biotic (fungi, insects, birds) and physical agents (insolation, drought); early development including effects of burned-over surfaces, overwood density, and relative aggressiveness of species; regeneration methods including clearcutting, seed tree, shelterwood, and selection. The authors conclude that, according to present (1941) knowledge, the clearcutting, seed tree, and shelterwood methods all deserve a place in the management of the western white pine type because forest conditions are too diverse for any one method to suffice.
KEYW Stand composition, regeneration, precipitation, temperature, fire damage, disease survey, insects, mortality, windthrow, cone crops, seed maturity, seed trees, seed storage, seed germination, seedling establishment, seedling mortality, overwood density, species aggressiveness, shelterwood cut, selection cutting.

223 AUTH Hamilton, D. A., Jr.
DATE 1974
TITL Event probabilities estimated by regression.
PUBL Research Paper INT-152. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 18 p.
ABST Describes a computer algorithm for fitting the relation between a dependent variable with only two possible values (for example, individual tree mortality) and a number of independent variables, and procedures for analyzing data from samples with unequal probability. Examples are given of the application of these programs, including estimation of the probability of individual tree mortality in sample plots of western white pine and investigation of natural inactivation of western white pine blister rust.
KEYW Statistical methods, stand characteristics, mortality, survival, decay in trees, assessment, fungus diseases, resistance.

224 AUTH Hamilton, D. A., Jr.
DATE 1981
TITL Large-scale color aerial photography as a tool in sampling for mortality rates.
PUBL Research Paper INT-269. Ogden, UT: U.S. Department of Agriculture, Forest Service,

Intermountain Forest and Range Experiment Station. 8 p.

ABST Lack of knowledge of mortality rates is primarily due to a lack of suitable data and inappropriate or inefficient data collection procedures. Test results indicate that 1-year mortality can be dated and that, with acceptable accuracy, species can be assigned to green trees and to 1-year mortality trees on 1:1600 and 1:2400 scale color aerial photography. These results have led to the design of a mortality sampling procedure that uses a $^1/_2$-mile strip (8 frames) of 70-mm true color aerial photography at a scale of 1:2400. Each frame covers 2.25 times the area covered by a frame at 1:1600. Use of this larger sample unit increases the likelihood of including some mortality on each sample unit.

KEYW Mortality rates.

225 AUTH Hanley, D. P.
DATE 1976
TITL Tree biomass and productivity estimated for three habitat types of northern Idaho.
PUBL Bulletin 14. Moscow, ID: University of Idaho, Forestry, Wildlife, and Range Experiment Station. 15 p.
ABST Biomass and productivity of coniferous trees of three habitat types in northern Idaho were determined by empirical formulas.
KEYW Habitat types, productivity estimates.

226 AUTH Hanover, J. W.
DATE 1962
TITL Clonal variation in western white pine. I. Graftability.
PUBL Research Note INT-101. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Periodic observations on ramets of thirteen western white pine clones show that individual trees vary in graftability. The type or degree of stock-scion incompatibility leading to poor grafting results also varies and may appear soon after grafting or years later. Detection of long-term incompatibility is not now possible. Survival of ramets appears to be related to vigor of ortets.
KEYW Scion mortality, scion growth, clonal variation, graftability, incompatibility.

227 AUTH Hanover, J. W.
DATE 1965
TITL Effect of the chemical mutagen ethyl methanesulfonate on western white pine.
PUBL Silvae Genetica. 14: 23-26.
ABST The chemical mutagen ethyl methanesulfonate (EMS) was applied in three different concentration-time combinations to control-pollinated western white pine seed after stratification. Eight progenies, including two from self-pollination, were compared for response to the treatments. EMS significantly affected percentage of germination. Time of germination, time of cotyledons, and cotyledon length were not affected. Variations in percentage of germination, germination time, and time of cotyledon opening indicated that individual progenies responded differentially to treatment. Self-pollinated progenies appeared less prone than outcrossed progenies to physiological damage by the mutagen. Examination of the second year's growth on all seedlings revealed one plant with stomatic mutations. These included yellow and green striped needles, yellow needles, dwarfed needles, and variation in number of needles per fascicle sheath.
KEYW Mutagen, mutations.

228 AUTH Hanover, J. W.
DATE 1966
TITL Environmental variation in the monoterpenes of *Pinus monticola* Dougl.
PUBL Phytochemistry. 5: 713-717.
ABST The concentrations of five monoterpenes in western white pine cortex oleoresin were measured by gas-liquid chromatography to determine how they vary with respect to certain environmental factors. Position on the tree relative to the sun and small differences in tissue age are both shown to have a predictable but small effect on terpene levels relative to genetic effects. Large differences in the age of tissues sampled within a single tree result in strikingly different patterns of terpene composition. The repeatabilities or intraclass correlations of monoterpene concentrations in western white pine are high. Genotypically identical plants (clones) growing in three diverse environments in Idaho show negligible differences in monoterpene levels, indicating that monoterpene concentration is quite stable with respect to many environmental factors. The data show that oleoresin from young, foliage-bearing tissue probably gives the most accurate measure of genotypic values for terpene concentrations.
KEYW Monoterpenes.

229 AUTH Hanover, J. W.
DATE 1966
TITL Genetics of terpenes. I. Gene control of monoterpene levels in *Pinus monticola* Dougl.
PUBL Heredity. 21: 73-84.
ABST Alpha-pinene, camphene, beta-pinene, 3-carene, limonene, one unidentified terpene, and total terpene content of cortex oleoresin

in clones, f_1 hybrids, and S_1 progeny of *Pinus monticola* were quantitatively analyzed using gas-liquid chromatography. The level of each monoterpene in a standard volume of oleoresin was shown to be significantly associated with genotype. The inheritance of each terpene except camphene is additive and also appears to include some heterotic or epistatic effects. Growth rate of the plants is negatively correlated with alpha-pinene and total terpenes ($p < 0.01$). Other significant negative correlations exist between beta-pinene and 3-carene, 3-carene and limonene, and limonene and the unidentified terpene. Positive correlations appear between alpha-pinene and limonene and between 3-carene and the unknown. The results indicate that some of the many possible molecular rearrangements in the terpenoids are under fairly rigid genetic regulation.

KEYW Monoterpenes.

230 AUTH Hanover, J. W.
DATE 1966
TITL Inheritance of 3-carene concentration in *Pinus monticola*.
PUBL Forest Science. 12: 447-450.
ABST Concentration of the monoterpene 3-carene in cortex oleoresin of *Pinus monticola* appears to be controlled primarily by single dominant and recessive alleles at a locus designated c/c. Some trees completely lack 3-carene, which indicates that an inhibitor may determine the presence or absence of this monoterpene in white pine.
KEYW Monoterpenes.

231 AUTH Hanover, J. W.
DATE 1971
TITL Genetics of terpenes. II. Genetic variances and interrelationships of monoterpene concentrations in *Pinus monticola*.
PUBL Heredity. 27: 237-245.
ABST Analyses of the monoterpene compounds in western white pine parents and progeny from a factorial mating design show that these chemicals are under strong, predictable genetic control probably involving one to several loci. One compound, beta-pinene, consistently occurs in substantially larger concentrations in progeny than in parents, which suggests an age effect of possible physiological significance. A strong positive relationship exists between the concentrations of 3-carene and terpinolene. Two other pairs of monoterpenes, alpha-pinene and beta-pinene and myrcene and 3-carene are negatively correlated. Except for these interrelationships, the compounds appear to be independently inherited. Negative correlations predominate between mono-terpene concentrations and mean progeny height growth rate. Further work is needed to determine the biological basis, if any, for this relationship.
KEYW Monoterpenes.

232 AUTH Hanover, J. W.
DATE 1974
TITL Comparative physiology of *Pinus strobus* L. and *Pinus monticola* Dougl.: oleoresin composition and viscosity.
PUBL American Journal of Botany. 61: 33.
ABST Eastern white pine and western white pine are two closely related but geographically separated species. Measurements of their foliage and stem cortex oleoresin chemistry and viscosity were made to determine the degree of genetic differentiation that has occurred between the two species for these characteristics. Significant quantitative differences in the monoterpenes camphene, b-pinene, limonene, and total monoterpenes were found. Thirteen diterpene resin acids were detected and all but one differed significantly in concentration between the species. Eastern white pine is characterized especially by having lower pimaric, isopimeric, and abietic acids and higher sandaracopimaric, dehydroabietic + strobic, and neoabietic acids than western white pine. The viscosity of eastern white pine oleoresin samples ranged from 9.2 to 160.6 poises with a mean of 44.0 poises. Western white pine viscosity ranged from 7.9 to 65.9 with a mean of 20.6 poises which differs from eastern white pine at the 0.001 level of probability. Thus the two species have qualitatively similar but quantitatively distinct oleoresin characteristics which may prove useful in interpreting their differential susceptibilities to certain insect and disease pests.
KEYW Physiology, oleoresin.

233 AUTH Hanover, J. W.
DATE 1975
TITL Comparative physiology of eastern and western white pines: oleoresin composition and viscosity.
PUBL Forest Science. 21: 214-221.
ABST Eastern white pine and western white pine are closely related but geographically separated species. Their foliage and stem cortex oleoresin chemistry and viscosity were measured to determine degree of genetic differentiation. From measurements of 40 seedlings of each species, significant quantitative differences in the monoterpenes caphene, ß-pinene, limonene, and total monoterpenes were found. Thirteen diter-

pene resin acids were detected and concentrations of all but one differed significantly between the species. Eastern white pine is characterized especially by lower pimaric, isopimaric, and abietic acids and higher sandaracopimaric, dehydroabietic + strobic, and neoabietic acids. Viscosity of eastern white pine oleoresin ranged from 9.2 to 160.6 poises with a mean of 44.0 poises; western white pine, from 7.9 to 65.9 with a mean of 20.6 poises, which differs significantly from eastern white pine. The two species have qualitatively similar but quantitatively distinct oleoresin characteristics which may prove useful in interpreting their differential susceptibilities to certain insects and diseases.

KEYW Monoterpenes, resin acids, genetic variation, physiology, oleoresin, viscosity.

234 AUTH Hanover, J. W., Barnes, B. V.
DATE 1962
TITL Heritability of height growth in year-old western white pine.
PUBL In: Proceedings, SAF southern forest tree improvement committee meeting forest genetics workshop; 1962 October; Macon, GA. p. 1-6.
ABST An analysis for computing heritability based on a modified diallel cross is described in detail using total height and epicotyl length of 1-year-old *Pinus monticola* seedlings. The data are used to analyze components of variance and obtain estimates of narrow-sense heritability for both growth traits. Epicotyl length is the more reliable measure of heritability, since seed weight and other nongenetic factors have less effect on this character. Results demonstrate the presence of a relatively high male-female interaction in height growth compared with variation due to additive gene action. Some implications of the results with regard to seed orchards are discussed.
KEYW Height growth, heritability growth.

235 AUTH Hanover, J. W., Barnes, B. V.
DATE 1969
TITL Heritability of height growth in western white pine seedlings.
PUBL Silvae Genetica. 18: 80-82.
ABST The inheritance of height growth of 1- and 2-year-old western white pine nursery seedlings was studied using a factorial design similar to the standard North Carolina design II. Variation in 1- and 2-year heights due to additive gene effects was estimated to account for 15.3 and 21.8 percent, respectively, of total variation based upon male parent variance; 52.4 and 50.0 percent based upon female parent variance; and 33.9 and 35.9 percent based upon the combined parental variances. Individual-tree variation within progenies was the major source of variability in height growth. For the improvement of western white pine, as many parents as possible, chosen at random from a natural population, should be used in heritability estimates. There is also need for new measures of progeny performance over reasonable ranges of site conditions.
KEYW Heritability growth, seedling growth.

236 AUTH Hanover, J. W., Hoff, R. J.
DATE 1966
TITL A comparison of phenolic constituents of *Pinus monticola* resistant and susceptible to *Cronartium ribicola*.
PUBL Plant Physiology. 19: 554-562.
ABST Polyphenols and simple phenols in *Pinus monticola* foliage and bark were studied in relation to host resistance to *Cronartium ribicola*. More than 50 phenolic substances were detected, but no qualitative differences were found between resistant and susceptible trees. Some evidence is given for a quantitative relationship between one polyphenol in white pine foliage and resistance to blister rust. This compound may be a guaiacyl derivative. Differences in phenolics due to tree-to-tree variation, needle age, tissue (foliage versus bark), and season of year are also reported.
KEYW Phenols, *Cronartium ribicola*.

237 AUTH Hanover, J. W., Hoff, R. J.
DATE 1966
TITL Pollination of western white pine with water suspensions of pollen—a technique for chemical mutagen treatments.
PUBL Forest Science. 12: 372-373.
ABST Pollen of western white pine was treated with water and the chemical mutagen ethyl methanesulfonate prior to wet pollination to test the effects of such treatments on seed set. Sound seed yield was below normal, but aqueous and chemical treatments of pollen and wet pollination are shown to be feasible.
KEYW Pollination mutagen.

238 AUTH Hansen, H. P.
DATE 1941
TITL Further pollen studies of post Pleistocene bogs in the Puget Sound lowland of Washington.
PUBL Bulletin of the Torrey Botanical Club. 68(3): 133-148.
ABST Pollen studies of two post-Pleistocene bogs showed past glacial forest succession patterns similar to those witnessed in other areas of the Puget lowland. Pioneer forests of lodgepole and western white pine were replaced abruptly by Douglas-fir. Western hemlock eventually takes its place in the

climax forest. The role of past climate trends in forest succession is discussed.
KEYW Pleistocene, bogs, pollen profiles, forest succession.

239 AUTH Hansen, H. P.
DATE 1943
TITL Post-Pleistocene forest succession in northern Idaho.
PUBL American Midland Naturalist. 30: 796-802.
ABST Pollen profile studies of a northern Idaho peat bog showed lodgepole pine to be the major pioneer tree species in post-Pleistocene forest succession. Western white pine gradually superceded it early in the profile and remained predominant throughout. The marked increase of western larch in a couple of western places indicates two periods of recurring fires. These fires are blamed for the lack of development of a climax forest in the profiles.
KEYW Post-Pleistocene forest succession, bog, pollen profiles, pioneer species, climax forest.

240 AUTH Hansen, H. P., Mackin, J. H.
DATE 1940
TITL A further study of interglacial peat from Washington.
PUBL Bulletin of the Torrey Botanical Club. 67: 131-142.
ABST Geological and stratigraphical relationships indicate the peat was deposited during the early part of the Puyallup Interglacial stage. Pollen analysis gives further insights into climatic trends and forest succession.
KEYW Interglacial peat, bog, pollen spectra, forest succession, climate, stratigraphic sequence.

241 AUTH Harlow, W. M.
DATE 1935
TITL *Pinus monticola* D. Don.
PUBL In: Dendrology of important trees of the United States. Part II - softwoods. Ann Arbor: Edward Brothers, Inc. p. 8.
ABST Gives a short description of western white pine's characteristics, range, and importance.
KEYW Dendrology, fruit, bark, leaves, wood, range, reproduction.

242 AUTH Harman, D. M., Brown, M. L.
DATE 1974
TITL Leader and bark characteristics in different growth categories of white pine (*Pinus strobus* L. and *Pinus monticola* Doug.) in Maryland.
PUBL Chesapeake Science. 15: 30-38.
ABST Dimensional and chemical aspects of leaders and bark were investigated in tall (40-75 ft) eastern white pine and in smaller (12-25 ft) trees growing in the open and shade. Leaders from young open-grown trees were longer, of greater diameter, and had thicker bark than leaders from tall white pine and from young shaded white pine. Tall trees were intermediate between the open-grown and shaded trees in leader length and diameter but had the thinnest bark. Bark thickness in similar-aged portions of laterals increased progressively at higher vertical levels in the trees. In spectrophotometer tests, light transmittance was higher for shoots than for bark from lateral branches and the main stem in both eastern white pine and western white pine.
KEYW Leader characteristics, bark characteristics, light transmittance.

243 AUTH Harris, J. M., Kripas, S.
DATE 1959
TITL Notes on the physical properties of ponderosa pine, monticola pine, western redcedar, and Lawson cypress grown in New Zealand.
PUBL New Zealand Forestry Research Note 16. 25 p.
ABST Although it was too early to make predictions of the quality of mature timber which may be produced by *P. monticola* grown in New Zealand, the physical properties of the timber examined from a 24-year-old stand were in many respects similar to those of the timber grown in the United States. This timber should be of value for uses requiring a wood of moderately low density with good machining qualities, light color, and good nailing properties, and which, according to American reports, "stays in place" when properly seasoned. The species also forms heartwood at an early age.
KEYW Physical properties, New Zealand, wood density, shrinkage.

244 AUTH Hartley, C., Merrill, T. C., Rhoads, A. S.
DATE 1918
TITL Seedling diseases of conifers.
PUBL Agricultural Research. 15: 521-559.
ABST Presents an extensive discussion of damping-off in conifer seedlings. Lists fungi known to be involved with some indication of their importance. *Corticium nagum* appears to be the most important parasite of damping-off in most species.
KEYW Disease survey, damping off.

245 AUTH Hartmann, R. K., Querengasser, R., Jahn, G.
DATE 1953

TITL Unterlagen fur den Anbau Westamerikanischer Nadelholzarten in Deutschland.
PUBL Allgemeine Forst- und Jagdzeitung. 125(1): 25-47.
ABST Summarizes planting data for western North American coniferous species in Germany, including western white pine. A summary table for each species is given.
KEYW Planting Germany.

246 AUTH Harvey, A. E.
DATE 1967
TITL Effect of phytoactin treatment on mycorrhizae-root consociations in western white pine.
PUBL Plant Disease Reporter. 51: 1012-1013.
ABST Applications of phytoactin 1,000 times greater than that (200 ppm) which has been applied to western white pine forests had no effect on the formulation or maintenance of normal mycorrhizal systems of 6-year-old seedlings.
KEYW Phytoactin, mycorrhizae-root associations.

247 AUTH Harvey, A. E.
DATE 1967
TITL Tissue culture of *Pinus monticola* on a chemically defined medium.
PUBL Canadian Journal of Botany. 45: 1783-1787.
ABST Procedures for obtaining and maintaining axenic tissue cultures of *Pinus monticola* are described. Western white pine tissue was cultured on a chemically defined medium containing calcium nitrate, magnesium sulfate, potassium phosphate (monobasic), ammonium sulfate, ferric sulfate, manganese sulfate, glucose, and one of three auxins, IAA, NAA, or 2,4-D. Addition of several B vitamins, amino acids, and kinetin increased growth on these media but were not required.
KEYW Tissue culture.

248 AUTH Harvey, A. E., Graham, S. O.
DATE 1969
TITL An effect of phytoactin treatment on western white pine seedlings.
PUBL Phytoprotection. 50: 53-58.
ABST The biological effects elicited by phytoactin against white pine blister rust may be the result of alterations in the protein metabolism of the host. Analyses have shown a general reduction in eight protein-bound amino acids in current-year needles 3 months after treatment with phytoactin. Also, the level of free aspartic acid increases in mature needles during this time. One year after treatment free aspartic acid decreased in current-year needles and free glumatic acid and alanine increased in mature needles.
KEYW Phytoactin, protein metabolism, aspartic acid, glumatic acid, alanine.

249 AUTH Harvey, A. E., Graham, S. O.
DATE 1969
TITL The extraction and assay of fungicidally active phytoactin from western white pine tissues.
PUBL Bulletin 715. Pullman, WA: Washington State Agricultural Experiment Station. 6 p.
ABST Phytoactins A and B were extracted and assayed as separate fractions from treated western pine tissues. Efficiency in extracting was dependent on removal of all free moisture and on the particle size of the sample. Anion gel filtration, followed by precipitation and collection of each fraction onto cellulose acetate filters, provided the means of isolation. These filters provided suitable assay disks for a modified paper disk plate assay. The method was quantitative and free from adsorptive complications.
KEYW Phytoactin, fungicidal assay.

250 AUTH Harvey, A. E., Grasham, J. L.
DATE 1969
TITL Procedures and media for obtaining tissue cultures of 12 conifer species.
PUBL Canadian Journal of Botany. 47: 547-549.
ABST Procedures for obtaining axenic tissue cultures of *Abies grandis, Larix occidentalis, Picea abies, Picea engelmannii, Picea pungens, Pinus albicaulis, Pinus contorta, Pinus flexilis, Pinus nigra, Pinus ponderosa, Pseudotsuga menziesii*, and *Thuja plicata* are described. All species were cultured on a basal medium containing calcium nitrate, magnesium sulphate, potassium phosphate (monobasic), ammonium sulfate, ferric sulfate, manganese sulfate, glucose, 3.8 percent bacto agar, and one of three auxins (indoleacetic acid (IAA), naphthaleneacetic acid (NAA), or 2,4-dichlorophenoxyacetic acid (2,4-D)) at various concentrations. Growth of most species was further enhanced by the addition of several vitamins and amino acids. These species were relatively specific in their auxin requirements. The type of sterilant (H_2O_2, NaOCL) and manipulation required in the preparatory procedures were also specific for individual species. Results are compared to previous results with western white pine.
KEYW Tissue culture.

251 AUTH Hedlin, A. F.
DATE 1957
TITL A comparison of insect species on pole blighted and healthy western white pine, *Pinus monticola* Dougl.
PUBL Bi-monthly Progress Report. 13(6): 1-2.

ABST The purpose of the study was to determine what insect species were associated with healthy and pole-blighted white pine trees. Results did not provide conclusive evidence that insects and mites are, in fact, responsible for or associated with the pole blight condition. Comparisons between healthy and pole blighted trees further suggest that the invertebrate fauna feeding activities do not contribute directly to pole blight of white pine. It is possible that some of the species found only on pole-blighted trees may act as vectors for the condition.
KEYW Pole blight, *Hylobius* larvae, mites.

252 AUTH Heimburger, C.
DATE 1961
TITL Comments.
PUBL Recent Advances in Botany. 2(14): 1699-1703.
ABST Problems concerning forest tree breeding are discussed. The author cites several efforts to improve on parent tree breeding. The inducement of early flowering, use of vegetative propagation, and hybrids are discussed.
KEYW Rooting, pine hybrids, mass propagation.

253 AUTH Heimburger, C.
DATE 1963
TITL The breeding of white pine for resistance to weevil.
PUBL In: World consultation on forest genetics and tree improvement; Stockholm, Sweden; (FAO) Section 6b. 2 p.
ABST The level of weevil resistance in *Pinus strobus* is compared to *P. peuce* and *P. monticola.* A breeding program is suggested with the purpose of transferring resistance from *P. peuce* and *P. monticola* to *P. strobus.*
KEYW Weevil, *Pissodes strobi*, *Pissodes approximatus*, resistance, grafting.

254 AUTH Helmers, A. E.
DATE 1936
TITL Effect of pruning on growth of western white pine.
PUBL Journal of Forestry. 44: 673-676.
ABST Pruning for production of clear lumber was being recognized more and more as a desirable silvicultural measure. The author's study on western white pine confirmed earlier findings on other species that not more than one-third of the live crown should be removed in any pruning operation.
KEYW Pruning, height growth, mortality, diameter growth, stand density.

255 AUTH Helmers, A. E.
DATE 1946
TITL Direct seeding western white pine—fifth-year results.
PUBL Research Note 44. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST These experiments show that reforestation of white pine by sowing seeds in spots can be successfully accomplished when adequate protection from seed-eating rodents is provided and the sowing is done in the fall on newly burned north slopes and flats. Poisoning the areas with 1 pound of thallium sulphate-coated hulled sunflower seeds per acre 1 week before sowing appears to provide the necessary protection. Although a test of broadcast sowing resulted in better stocking than seed spotting in that particular instance, broadcast sowing must be more thoroughly tested before conclusions can be made. Seed spot sowing was successfully accomplished on an administrative scale at about the same cost as that of planting nursery seedling stock.
KEYW Direct seeding.

256 AUTH Helmers, A. E.
DATE 1946
TITL How heavily should western white pine be pruned?
PUBL Research Note 41. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Three tests were initiated in the fall of 1940 to determine the height to which western white pine trees can be pruned without seriously retarding growth. The evidence indicates that only about one-third of the live crown can be removed without substantially lowering the rates of growth, both in diameter and in height.
KEYW Pruning.

257 AUTH Helmers, A. E.
DATE 1946
TITL Pruning wound healing on western white and ponderosa pines.
PUBL Research Note 45. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 6 p.
ABST These experiments indicate that pruning is most effective in young plantations or in moderately open young natural stands. In such stands, pruning to a height of 17 ft will require two or three successive operations. Conditions affecting the rate of healing are partially compensating. In very open stands, for example, the large branches result in large wounds but the trees are relatively fast-

growing and most of the branches are alive when pruned. In dense stands, the trees usually grow more slowly, and most of the limbs are dead when pruned; but, on the other hand, the limbs tend to be small. Close pruning results in smaller knotty cores and more rapid wound healing. However, this method of pruning takes more time because of the larger area of the cuts, and the greater care required to cut accurately and closely. Optimum conditions for rapid wound healing result from close pruning small live branches on rapidly growing trees.

KEYW Pruning.

258 AUTH Helmers, A. E.
DATE 1948
TITL Early results from thinning seed spots.
PUBL Research Note 58. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST The results of this experiment show that, although the effect of number of seedlings per seed spot on the height growth is of little practical consequence, there is a pronounced effect on diameter growth of 9-year-old Engelmann spruce, western white pine, and ponderosa pine seedlings originating from direct sowing. These early results do not prove or disprove the need for thinning seed spots.
KEYW Thinning, direct seeding.

259 AUTH Hepting, G. H.
DATE 1971
TITL Western white pine: *Pinus monticola*.
PUBL In: Diseases of forest and shade trees of the United States. Agriculture Handbook 386. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 322-326.
ABST Gives a brief description of the tree species and then lists seedling diseases, foliage diseases, stem diseases, root diseases, trunk rots, and mycorrhizal relations.
KEYW Diseases, seedlings, stem, foliage, roots, trunk, mycorrhizae.

260 AUTH Hermann, A.
DATE 1960
TITL Western pine glued-cleat sheathing panel.
PUBL Western Pine Association Research Note 8. p. 7-101.
ABST Testing of western white pine glued-cleat sheathing panels was undertaken in an attempt to improve marketability of the product. The author recommends certain construction criteria for the sheathing and lists suggested applications.
KEYW Utilization, wood sheathing.

261 AUTH Hill, R. B.
DATE 1959
TITL A study of leader elongation in western white pine.
PUBL Moscow, ID: University of Idaho. 52 p. M.S. thesis.
ABST In a study of leader elongation in western white pine, progenies from control-pollinations and grafts made from rust-resistant selections were measured for leader growth on two plots during the growing period in 1958. Progenies selected were descended from fast-growing and slow-growing parents growing at two elevations with a difference in altitude of 2,150 ft. Growth points of 5, 50, and 95 percent were computed for a selected group of progenies, and grafts chosen to represent the differences in altitude of their origin and their parents' growth rates. Also, the time or date when these growth points were reached was computed. The progenies and grafts displayed differences in amount of leader elongation consistent with their parents' differences in most, but not all, cases. The amount of leader growth was significantly different between two fast-growing progenies: one from a high elevation seed source and the other from a low altitude. The progenies from the low altitudes made the best growth. An "f" test disclosed significant difference due to elevation on one plot. Cessation of leader elongation was markedly different in one plot in a comparison between progenies from different elevations leading to the conclusion that the cessation of height growth is probably under genetic control. Rate of growth was also affected here and is probably a hereditary factor.
KEYW Leader elongation, provenance test.

262 AUTH Hobbs, S. D., Partridge, A. D.
DATE 1979
TITL Wood decays, root rots, and stand composition along an elevation gradient.
PUBL Forest Science. 25(1): 31-42.
ABST Seventy-four randomly selected stands of mixed conifers were examined for wood-decaying fungi in northern Idaho during 1974 and 1975. Stands were ordinated two-dimensionally based on the presence of all vascular plants. The ensuing ordination approximated an elevation gradient. An agglomerative cluster analysis was used to classify stands into discrete units based on the presence of coniferous trees. The wood decaying fungi identified were *Armillaria mellea, Echinodontium tinctorium, Phellinus pini, Phaeolus schweinitzii, Polyporus sericeomollis, Inonotus tomentosus, Perenniporia subacida*, and *Phellinus weirii.*

Fungi distributions and stand composition changed with increasing elevation.
KEYW Agglomerative cluster analysis, ordination, succession, wood decaying fungi.

263 AUTH Hoekstra, P. E., Merkel, E. P., Powers, H. R.
DATE 1961
TITL Production of seeds of forest trees.
PUBL In: Yearbook of Agriculture. Washington, DC: U.S. Department of Agriculture. 227-232.
ABST This article gives an overview of forest tree seed production in the United States. Genetic quality of most of the tree seed being produced (in 1961) was unknown. Various programs are discussed.
KEYW Seed production, seed orchards.

264 AUTH Hoff, R. J.
DATE 1968
TITL Chemical verification of the hybrid of *Pinus monticola* and *Pinus flexilis.*
PUBL Forest Science. 14: 119-121.
ABST A positive identification of the hybrid seedlings of *Pinus monticola* and *P. flexilis* can be made by chromatographic techniques. *Pinus monticola* extracts contain a phenolic compound lacking in *P. flexilis* and conversely *P. flexilis* extracts contain a compound lacking in *P. monticola.* The hybrid extracts contain both compounds.
KEYW *Pinus monticola* x *P. flexilis*, phenols, chromatography.

265 AUTH Hoff, R. J.
DATE 1977
TITL Delayed graft incompatibility in western white pine.
PUBL Research Note INT-215. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST A form of graft incompatibility was observed 11 years after a seed orchard of grafted western white pine was established. After 16 years, over 60 percent mortality had occurred in four of the 13 clones studied, and two more were beginning to show symptoms of graft incompatibility.
KEYW Graft incompatiblity, seed orchards, graft seed orchard.

266 AUTH Hoff, R. J.
DATE 1981
TITL Cone production of western white pine seedlings and grafts.
PUBL Research Note INT-315. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Grafts of western white pine planted in a seed orchard within the white pine type produced six cones per tree 11 years after grafting; grafts of the same families in a breeding arboretum located on a grassland habitat produced 1.6 cones per tree 14 years after grafting. Seedlings in the breeding arboretum produced 1.2 cones per tree at 12 years of age. Placement of seed orchards of western white pine is discussed.
KEYW Cone production, seed orchards, grafts.

267 AUTH Hoff, R. J., Coffen, D. O.
DATE 1982
TITL Recommendations for selection and management of seed orchards of western white pine.
PUBL Research Note INT-325. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 7 p.
ABST Seed orchards of western white pine should be located on flat sites within the botanical range of western white pine. They should be planted at a 6- by 6-m spacing, and they should be sprinkler irrigated, fertilized in August with 300 lb/acre ammonium nitrate, and sown with grass. Trees should be top pruned at 3 m and managed so that they develop three to four tops. Basal branches should be pruned to provide fire and rodent protection. A mechanical lift should be used to harvest cones when they are starting to open. Trees should be sanitized by removing all cones to decrease insect infestation. All trees should be tagged and the amount of pollen, number of cones, ripening day, and seed-germination capacity recorded for each individual tree.
KEYW Seed orchards, seed orchard management.

268 AUTH Hoff, R. J., McDonald, G. I.
DATE 1968
TITL Rooting of needle fascicles from western white pine seedlings.
PUBL Research Note INT-80. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST In one test, 45 out of 318 (14 percent) needle fascicles from 2-year-old seedlings of *Pinus monticola* were rooted. Eight of the needle fascicles produced shoot growth. In another test, 392 out of 742 (53 percent) needle fascicles were rooted, but none of these produced shoot growth.
KEYW Rooting, needle fascicles, cultural treatments.

269 AUTH Hoff, R. J., McDonald, G. I.
DATE 1977
TITL Differential susceptibility of 19 white pine species to woolly aphid (*Pineus coloradensis*).
PUBL Research Note INT-225. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Several species of white pine appeared to be completely resistant to woolly aphid; others were highly susceptible. The level of infestation tended to be highest for species in subsection *Strobi,* for species from the North American continent, and for species that are most susceptible to white pine blister rust.
KEYW Woolly aphid, *Pineus coloradensis*, resistance (insects).

270 AUTH Hoff, R. J., McDonald, G. I.
DATE 1978
TITL Genetic variation in susceptibility of western white pine to needle blight.
PUBL Research Note INT-249. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Ten clones of western white pine differed in their susceptibility to white pine needle blight. Two clones were significantly less infected than the average. This variability suggests a simple inheritance, maybe just one or two genes.
KEYW White pine needle blight, *Lecanosticta*, disease resistance.

271 AUTH Hoff, R. J., Steinhoff, R. J.
DATE 1980
TITL Comparative growth rates of western white pine varieties resistant to blister rust.
PUBL Research Note INT-290. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 5 p.
ABST The growth of seedlings of western white pine that displayed specific mechanisms of resistance in response to white pine blister rust was compared. These growth statistics were then compared to those of seedlings that had blister rust cankers. No difference was detected among these categories.
KEYW Growth and blister rust resistance.

272 AUTH Hoff, R. J., Steinhoff, R. J.
DATE 1984
TITL Short internodes in western white pine.
PUBL Research Note INT-344. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 7 p.
ABST Irregularities in growth at the top of western white pine trees were related to three causes: (1) death of the terminal bud while dormant, (2) current-year terminal killed by insects, and (3) succulent terminal broken (usually by birds). In about half the cases, the broken succulent terminal also dies. In all irregularities related to causes 1 and 2, and those of cause 3 where the terminal died, lateral branches turned upward to replace the terminal, resulting in a moderate growth loss. On the broken succulent terminals that survived, one or more fascicular buds appeared. Evidence that such fascicular buds develop into new terminals was seen on growth from preceding years, and it is presumed that those on the current year's growth will also do so. In most cases, however, the internode will be very short for the year in which breakage occurs.
KEYW Western white pine, short internodes, tree top damage.

273 AUTH Hofmann, J. V.
DATE 1917
TITL Natural reproduction from seed stored in the forest floor.
PUBL Agricultural Research. 11: 1-26.
ABST The study of burns and cut-over areas in the Douglas-fir region of the Pacific Northwest has brought out the following facts: (1) The distance to which seed trees are capable of restocking is limited to from 150 to 300 ft. They cannot, therefore, account for the restocking of the large burned areas. (2) The irregular, dense stands of young growth are due to seed stored in the forest floor or in cones. This seed retains its viability through the fire and is responsible for the dense reproduction that springs up after the first fire. (3) The even-aged stands of reproduction immediately following a fire (regardless of location of remaining seed trees), the irregular alternation of dense stands of reproduction with grass areas, and the failure of reproduction on areas burned over by a second fire before the stand reaches seeding age or by consuming all of the duff and precluding any possibility of seed remaining after the fire, all point to the seed stored in the duff as the principal source of seed responsible for the restocking. (4) The ability of the seed to retain its viability when stored in the duff or when retained in cones during fires has been further demonstrated by recovering and germinating seed from duff under forest conditions and by recovering and germinating seed from cones which passed through a crown fire. In this study, the mature forest before the burn contained about 5

percent white pine; after the burn, reproduction constituted 10 percent of the stand.

KEYW Seed storage, natural reproduction, duff storage—seed, restocking, seed viability, reproduction after fire.

274 AUTH Hofmann, J. V.
DATE 1918
TITL The importance of seed characteristics in the natural reproduction of coniferous forests.
PUBL Bulletin 2. Minneapolis, MN: University of Minnesota. 25 p.
ABST All forest tree species in forest stands produce sufficient seed to reestablish their own type under favorable conditions, and a change of type or removal of a forest from any area once covered with a forest is due to other factors than production of seed. Species producing large seeds produce comparatively few in number. Seed distribution is one of the important factors controlling the establishment of a forest type. In the white pine region of Idaho, reproduction by wind-blown seed cannot be depended upon for more than 150 feet from the seed trees. Germination conditions are often unfavorable in a shaded and cool forest floor; hence, seed may lie dormant for long periods. By the removal of a forest, germinating conditions are improved, and the dormant seed germinates. Moisture is the chief factor in the establishment of the seedling, while temperature is often a more important factor in germination. A seedling from a large seed becomes permanently established much earlier than a seedling grown from a small seed, hence the former is able to obtain and hold possession of the more favorable sites. Some seed, while dormant, will withstand severe conditions, as shown by chemical tests. Coniferous seeds are known to be viable after 2 to 8 years of storage in the forest floor.
KEYW Seed characteristics, seed distribution, seed migration, seed germination, seed size, seed viability, chemical treatment—seed.

275 AUTH Holmes, P. N.
DATE 1947
TITL 1945 lumber production in the Northern Rocky Mountain Region.
PUBL Research Note 49. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The following statistics are given for western white pine: total lumber production in 1944 was 292,330 thousand bd ft; in 1945, 238,364 thousand bd ft, showing an 18 percent decrease.
KEYW Production lumber.

276 AUTH Howard, J. O.
DATE 1973
TITL The timber resources of central Washington.
PUBL Research Bulletin PNW-45. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 68 p.
ABST Gives area of commercial forest land by type, species, diameter, county, and ownership. The following figures are given for western white pine in central Washington as of January 1, 1968: area of commercial forest land, 13,000 acres; number of growing stock trees, all classes, 5,975 thousand; volume of all growing stock, 136 million cubic feet; volume of sawtimber, 707 million bd ft.
KEYW Commercial forest area, growing stock, growing stock volume, sawtimber volume, forest survey, forest appraisal, Washington.

277 AUTH Howe, J. P., Bently, M. M., Bricker, C. O.
DATE 1973
TITL The production of bark in Idaho's forest industries.
PUBL Note 20. Moscow, ID: University of Idaho, Forestry, Wildlife, and Range Experiment Station. 4 p.
ABST Bark production for western white pine in Idaho is listed as 92,092 units for 1971-1972. Bark production by species and counties is also listed.
KEYW Bark production, Idaho.

278 AUTH Huberman, M. A.
DATE 1935
TITL The role of western white pine in forest succession in northern Idaho.
PUBL Ecology. 16: 137-151.
ABST This paper discusses the character of the vegetation of the subclimax and near-climax forests of the "western white pine type" in northern Idaho. Phytographs were constructed using data on size-class distributions, abundance and frequency percentages, and basal area. Evidence shows that white pine appears mostly in the early stages of succession, playing a very minor part in the climax forest. A discussion of the successional relationships of western white pine points to an early cutting age as a means of preventing the replacement of this species by the less valuable climax species.
KEYW Succession status.

279 AUTH Hubert, E. E.
DATE 1920
TITL The disposal of infected slash on timber-sale areas in the Northwest.
PUBL Journal of Forestry. 18: 34-56.
ABST Reports on studies of factors affecting sporophore production and makes suggestions for

forest sanitation. It was found that all of the most destructive wood rotting fungi operating in the forests of the Northwest develop fruiting bodies on their hosts after the tree is cut. Hubert believed slash furnishes a serious source of infection to the remaining stand. *Trametes pini* sporo-phores were recovered from infected slash of western white pine.

KEYW Slash disposal, wood rotting fungi, forest sanitation, *Trametes pini*.

280 AUTH Hubert, E. E.
DATE 1923
TITL Contribution to McNary Committee Report.
PUBL Unpublished manuscript on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Sciences Laboratory, Moscow, ID.
ABST Summarizes knowledge concerning disease losses in forests of Montana and Idaho. White pine is listed as approximately one-third of the timber resource in Idaho but only 2 percent in Montana. Diseases listed for standing green timber are heart rots, root rots, and needle diseases.
KEYW Fungi, false mistletoes, loss estimates, timber resource.

281 AUTH Hubert, E. E.
DATE 1925
TITL Forest diseases and losses with figures to demonstrate the toll of fungi and disease.
PUBL The Timberman. 25(1): 225-226.
ABST Gives an overview of the disease problem in Oregon, Washington, and northern California forests. Estimated percent defect in western white pine was 2.5-3.0 percent in Oregon and Washington, the lowest of any species listed.
KEYW Fungi, disease losses, percent defect.

282 AUTH Hubert, E. E.
DATE 1926
TITL The brown stains of lumber.
PUBL The Timberman. 26(5): 44-50.
ABST Discusses brown stains in pine lumber at length. Causes for the stains in western white pine are listed as certain combinations of temperature and relative humidity during kiln drying, machine or kiln burns, water stain, and fungi.
KEYW Brown stain, kiln drying, yard drying.

283 AUTH Hubert, E. E.
DATE 1927
TITL Manual of wood rots for cruisers and scalers in the Inland Empire.
PUBL The Timberman. January p. 27-46; February p. 43-48; March p. 48-52; April p. 48-53.
ABST The following wood rots are described for western white pine: *Trametes pini* (red ring rot), *Polyporus schweinitzii* (red brown butt rot), root rots (*Fomes annosus*, *Poria subacida*), white pocket rots (in downed timber), white pine blister rust.
KEYW Wood rot, *Trametes pini*, *Polyporus schweinitzii*, *Fomes annosus*, *Poria subacida*, white pocket rot, root rots.

284 AUTH Hubert, E. E.
DATE 1930
TITL Winter injury of conifers.
PUBL Unpublished report on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Sciences Laboratory, Moscow, ID.
ABST Report consists of two tables summarizing winter injury and other damage to conifers from 1908 to 1929.
KEYW Winter injury of conifers.

285 AUTH Hubert, E. E.
DATE 1932
TITL The honey mushroom in white pine stands.
PUBL Unpublished manuscript on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Sciences Laboratory, Moscow, ID.
ABST *Armillaria mellea* is prevalent throughout the white pine type in Idaho, and is often noted in thrifty dense stands of young white pine. The disease takes a heavy toll in coniferous forests, but the losses are not easily evaluated. The fungus is parasitic, attacking the sapwood and killing the cambium of the infected trees.
KEYW *Armillaria mellea*

286 AUTH Hubert, E. E.
DATE 1949
TITL Pole blight: a summary of information and suggested tests.
PUBL Unpublished manuscript on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Sciences Laboratory, Moscow, ID.
ABST Summarizes what is known about pole blight and suggests future research. Fungi listed are: *Armillaria mellea*, *Fomes annosus*, *Poria subacida*, *Sparassis radicata*; and *Rhizina inflata*. The principal insect listed was *Dendroctonus ponderosae*.
KEYW *Fomes annosus*, *Poria subacida*, *Sparassis radicata*, *Rhizina inflata*, pole blight, *Armillaria mellea*, *Dendroctonus ponderosae*.

287 AUTH Hubert, E. E.
DATE 1950

TITL Rootrots of the western white pine type.
PUBL Northwest Science. 24(1): 5-17.
ABST Reports on an intensive study made of the four most important root rots of the western white pine type: *Armillaria mellea*, *Poria subacida*, *Fomes annosus*, and *Poria weirii*. Symptoms, signs, and cultural characteristics of four root rot species are compared. Root rot control is also discussed.
KEYW *Armillaria mellea*, *Poria subacida*, *Fomes annosus*, *Poria weirii*, root rots, decay, root rot control.

288 AUTH Hubert, E. E.
DATE 1951
TITL Hubert making study of Idaho pine pole blight.
PUBL The Forest Log. 20(10): 2.
ABST Describes Hubert's work with pole blight.
KEYW Pole blight.

289 AUTH Hubert, E. E.
DATE 1953
TITL Studies of *Leptographium* isolated from western white pine.
PUBL Phytopathology. 43: 637-641.
ABST The objective of this study was to determine if *Leptographium* spp. could be considered a primary cause of pole blight and to gain some information regarding phytotoxins produced by this fungus. Inoculation experiments established the ability of this organism to produce lesions in the bark of its host and to cause death of seedlings under certain conditions. Wounding of the bark proved to be necessary for infection. Similar species apparently differing in virulence were found both within and outside the present known spread limits of pole blight. The inoculation and phytotoxin tests indicated that *Leptographium* spp. is not a primary cause of death of trees showing pole blight symptoms.
KEYW Pole blight, *Leptographium*, phytotoxins, inoculation.

290 AUTH Hubert, E. E.
DATE 1953
TITL A study of recently killed trees in the western white pine type.
PUBL Journal of Forestry. 51: 624-627.
ABST The prevalence of agents other than pole blight found associated with recently killed trees is reported.
KEYW Mortality, pole blight, *Armillaria mellea*.

291 AUTH Hubert, E. E.
DATE 1955
TITL Translocation of past bark lesions on young western white pine.
PUBL Plant Disease Reporter. 39(6): 500-503.
ABST This study reports findings of tests conducted to trace upward and downward movement of radio-phosphorus past bark lesions on western white pine. The fungus used to produce the lesions was a species of *Leptographium*, isolated from a root of a pole-blighted tree. Branch and stem lesions had no appreciable effect on the movement of the tracer. However, tracer movement upward past root lesions was greatly curtailed. This is supported by microscopic examination, which shows greater deterioration of tissues in root lesions when compared with branch or stem lesions. It is postulated that tracer recovered beyond lesions was transported by the xylem.
KEYW *Leptographium*, pole blight, bark lesions, tracer, radio-phosphorus.

292 AUTH Hubert, E. E., Ferrell, W. K.
DATE 1952
TITL Radioisotope tests of translocation in artificially infected *Pinus monticola* Dougl.
PUBL Phytopathology. 42: 515. Abstract.
ABST The University of Idaho was conducting studies to determine the cause of a new damaging disease of western white pine known as pole blight. Symptoms of this disease were appearing on 60,000 acres of pole size timber in northern Idaho, western Montana, and British Columbia, and many trees were dying. Tests were being conducted to determine the effect on translocation in the tree of certain fungi isolated from pole blighted trees. Radioactive phosphorus was introduced into the xylem and the phloem to determine whether the bark lesions resulting from artificial inoculations caused any changes in translocation or absorption of the introduced solutions. The first series of tests were conducted using cultures of *Leptographium* spp. as the inoculum on root, trunk, and branch tissues of small saplings in the greenhouse. Some evidence based on preliminary results indicated that bark lesions on the trunk seriously obstructed the downward movement of P32 in the phloem.
KEYW Radioisotopes, translocation, artificial inoculation, *Leptographium*.

293 AUTH Huey, B. M.
DATE 1950
TITL The profit in pruning western white and ponderosa pine.
PUBL Research Note 85. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 6 p.
ABST Pruning of both of the western pines appears to be a profitable forest practice. For

example, a pruned butt log of white pine, having a 4-inch knotty core and harvested at 21 inches d.b.h., will yield $48.56 more per thousand (in 1950) after pruning costs than an identical unpruned log.

KEYW Pruning.

294 AUTH Hughes, P. R.
DATE 1973
TITL Effect of a-pinene exposure on trans-verbenol synthesis in *Dendroctonus ponderosae* Hopk.
PUBL Naturwissenschaften. 60: 261-262.
ABST Exposure of both sexes of *Dendroctonus ponderosae* to air saturated with a-pinene rapidly initiates or increases the biosynthesis of trans-verbenol, which acts as this insect's principal aggregating pheromone.
KEYW *Dendroctonus ponderosae,* trans-verbenol synthesis.

295 AUTH Hungerford, R. D.
DATE 1973
TITL Drought crack on western white pine in northern Idaho.
PUBL Forest Science. 19: 77-80.
ABST In September of 1967, one western white pine in northern Idaho had external cracks which were not apparent 3 months earlier. This fact, together with observation of climatic data, site conditions, and wood anatomy, suggest that cracking resulted from moisture stress. Inherent structural weaknesses of the wood apparently predisposed the tree stem to cracking during the drought.
KEYW Xylem, moisture stress, tracheids, drought crack.

296 AUTH Hunt, R. S., Von Rudloff, E.
DATE 1977
TITL Leaf-oil terpene variation in western white pine populations of the Pacific Northwest.
PUBL Forest Science. 23: 507-516.
ABST The volatile leaf oil of western white pine was analyzed. In addition to the typical monoterpenes, (-) ß-elemene, caryophyllene, as well as (-) ß-selinene, cadinene isomers and their corresponding alcohols, and manool were isolated. The quantitative variation within tree, from tree to tree, and among populations from British Columbia and Washington was determined. The composition of the leaf oil from known healthy trees or resistant crosses was compared with that of blister rust-infected trees; no correspondence between disease resistance and terpene composition was found. The foliage of one heavily infected tree had a markedly different quantitative terpene composition on resampling 1 year later. Other healthy or infected trees showed no change. One hundred and eighty trees from 10 coastal and 10 interior populations were sampled. Within-population variation was generally much higher than that between populations, and most monoterpene, all sesquiterpene, and the manool percentages showed no regional differences. Minor clustering of populations from Vancouver Island and the Olympic Peninsula on the basis of ß-pinene was found; those from the Cascade Mountains clustered with interior populations.
KEYW Chemosystematic study, leaf-oil terpene variation, monoterpenes, sesquiterpenes, provenance test.

297 AUTH Hutchison, S. B.
DATE 1938
TITL A century of lumbering in northern Idaho. Parts I-III.
PUBL The Timberman. 39(10): 20-21, 26; 39(11): 15, 28; 39(12): 35-36, 38-39.
ABST This three-part article gives a historic account of lumbering activities in northern Idaho. The importance of western white pine as a timber species during this early period is well documented.
KEYW Lumbering, history.

298 AUTH Hutchison, S. B.
DATE 1948
TITL Comparative marketability of pine and mixed species in the Inland Empire.
PUBL Research Note 64. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST These charts document the wide difference between the pine indexes and the indexes for the mixed species. Regardless of how the position of the mixed species changes in coming years, the wide margin between the indexes for these species and the indexes for ponderosa pine and white pine will probably continue. White pine has been a preferred species in the United States for three centuries. For the shorter period, since the West was opened up, ponderosa pine has likewise been preferred. There is no sign that this preference, which has meant higher prices and higher profits, will not continue.
KEYW Marketability.

299 AUTH Hutchison, S. B., Kemp, P. D.
DATE 1952
TITL Forest resources of Montana.
PUBL Forest Resource Report 5. Washington, DC: U.S. Department of Agriculture. 76 p.
ABST Western white pine was the least common species listed for Montana, with 0.2 billion

cubic feet for all timber and 1.1 billion bd ft for sawtimber. However, white pine and its three associates occupied some of the most productive forest land in the State.

KEYW Forest resource, Montana, timber supply.

300 AUTH Hutchison, S. B., Winters, R. K.
DATE 1942
TITL Northern Idaho forest resources and industries.
PUBL Miscellaneous Publication 508. Washington, DC: U.S. Department of Agriculture. 75 p.
ABST The paper stressed the fact that western white pine was being cut disproportionately to other species. Allowable annual cut for western white pine was 140 million bd ft; actual cut was 351 million bd ft. The great overcut of western white pine was on lands other than National Forests. The paper predicted an annual cut of western white pine as low as 70 million bd ft by 1959 if the present drain continued.
KEYW Forest resource, northern Idaho, industry, ownership, fire, economy, allowable annual cut.

301 AUTH Isaac, L. A.
DATE 1930
TITL Seed flight in the Douglas-fir region.
PUBL Journal of Forestry. 28: 492-499.
ABST Some of these tests were from a box kite at 100-ft elevation and some from a pilot balloon at 150-ft elevation. White pine seed was disseminated farther than yellow (ponderosa) pine or Douglas-fir in the balloon test. Overall results indicate that the abundance of the crop, height of release, wind velocity, and tree species all have a bearing on distance and density of seed distribution.
KEYW Seed flight, seed fall.

302 AUTH Jackson, M. T., Faller, A.
DATE 1973
TITL Structural analysis and dynamics of the plant communities of Wizard Island, Crater Lake National Park.
PUBL Ecological Monographs. 43: 441-461.
ABST *Pinus monticola* is listed as an important tree species (the only one other than *Abies magnifica* and *Tsuga mertensiana*) on Wizard Island, Crater Lake, OR.
KEYW Crater Lake, Oregon, distribution.

303 AUTH Jantz, O. K., Rudinsky, J. A.
DATE 1965
TITL Laboratory and field methods for assaying olfactory responses of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins.
PUBL Canadian Entomologist. 97: 935-941.
ABST Laboratory tests revealed that female Douglas-fir beetles, *Dendroctonus pseudotsugae*, boring in logs of both host and nonhost species produce a volatile substance that both attracts and arrests adult beetles. Male arrestment provided a reliable method for laboratory bioassay of volatile substances. Field tests were devised to show the attack, the attraction produced, and the broad development in six tree species: Douglas-fir, western larch, ponderosa pine, western hemlock, western white pine, and grand fir.
KEYW *Dendroctonus pseudotsugae*, olfactory response, attractants, attack insect, brood development.

304 AUTH Jayne, B. A.
DATE 1960
TITL Some mechanical properties of wood fibers in tension.
PUBL Forest Products Journal. 10: 316-322.
ABST Load-deformation properties of single fibers of wood were measured by means of an electrical-mechanical system for measuring force and deformation. Data from tests of 10 coniferous trees show vast differences between species and often between earlywood and latewood fibers of a single species.
KEYW Wood fiber, load deformation, early wood, late wood, wood stress properties.

305 AUTH Jenkins, M. J.
DATE 1982
TITL Western white pine: the effect of clone and cone color on attacks by the mountain pine cone beetle.
PUBL Logan, UT: Utah State University. 91 p. Ph.D. dissertation.
ABST The relationship between clone and cone color in western white pine, *Pinus monticola*, to attack by the mountain pine cone beetle, *Conophthorus monticolae*, was studied in the Sandpoint Seed Orchard, Idaho. A positive relationship was shown to exist during a 5-year field evaluation. Cone beetles were found to prefer dark-colored cones and to attack certain clones at a higher rate than others. Laboratory dissections did not indicate that cone color affected oviposition, brood development, or brood mortality. Olfactometer experiments demonstrated that olfactory stimuli are involved in the cone beetle attack sequence. Visual cues relating to cone color may be involved in the initial long-range host orientation of attacking beetles.
KEYW Mountain pine cone beetle, *Conophthorus monticolae*, cone color, resistance to cone beetle.

306 AUTH Jenkins, M. J.
DATE 1983

TITL Relationship between attacks by the mountain pine cone beetle (*Coleoptera: Scolytidae*) to clone and cone color in western white pine.
PUBL Environmental Entomology. 12(4): 1289-1292.
ABST Total cones produced by western white pine and total number attacked by the mountain pine cone beetle (*Conophthorus ponderosae* = *C. monticolae*) were counted during a 5-year study in the Sandpoint Seed Orchard, Sandpoint, ID. Cone production and level of beetle attack varied with clone, cone color class, and year. Certain western white pine clones were attacked at consistently higher rates than other clones. In years when cone production and percentage of cone attack were high, cone beetles showed preference for dark-colored over light-colored cones.
KEYW Mountain pine beetle, cone color, resistance to mountain pine beetle.

307 AUTH Jenkins, S. J.
DATE 1939
TITL Selective logging in Idaho.
PUBL Trees Magazine. 2(2): 9-15.
ABST Here is a plan of permanent forest management; the entire area is classified into four types of stands: (1) White pine dominates by more than 70 percent. Sixty percent of the volume is cut, but under no circumstance is any tree taken that has a diameter at breast height of less than 17 inches. (2) White pine in dominance from 40 to 69 percent. Here, half the volume is removed with the average diameter 14 to 16 inches. (3) Other species predominate and the white pine stands only 10 to 39 percent. Forty percent of this volume is taken, including some mixed species, with about the same diameter limits as in type two. (4) The mixed species type where white pine is less than 10 percent of the stand. None of this type is cut.
KEYW Selective logging.

308 AUTH Johnson, F. A.
DATE 1955
TITL Volume tables for Pacific Northwest trees.
PUBL Handbook 92. Washington, DC: U.S. Department of Agriculture, Forest Service. 122 p.
ABST Contains volume tables for several species, including cubic-foot and board-foot tables for western white pine.
KEYW Volume tables, Pacific Northwest.

309 AUTH Johnson, P. C., Schmitz, R. F.
DATE 1965
TITL *Dendroctonus ponderosae* Hopkins (Coleoptera: Scolytidae), a pest of western white and ponderosa pines in the Northern Rocky Mountains: a problem analysis.
PUBL Unpublished report on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID. 87 p.
ABST Largely a study of *Dendroctonus ponderosae,* this report contains information on relationships between the beetle and its host tree. Mechanical injury, foliage and bole deterioration, host tree resistance, and tree vigor classifications are discussed.
KEYW *Dendroctonus ponderosae.*

310 AUTH Johnstone, G. R.
DATE 1940
TITL Further studies on polyembryony and germination of polyembryonic pine seeds.
PUBL American Journal of Botany. 27: 808-811.
ABST Germination tests and dissection of mature seeds show polyembryony multiple seedlings to be present in the 11 species of pine studied. Frequency of occurrence of polyembryony (selective development of multiple seedlings) among the several species is discussed.
KEYW Polyembryony, multiple seedlings, selective development, embryo, pine seed.

311 AUTH Keen, F. P.
DATE 1958
TITL Cone and seed insects of western forest trees.
PUBL Technical Bulletin 1169. Washington, DC: U.S. Department of Agriculture, Forest Service. 168 p.
ABST The bulletin notes that very little information is available on cone damage of western white pine. Insect species listed are: *Conophthorus monticolae*, *Conophthorus lambertiana*, *Doiryctria* sp. (prop. *abietella*), and *Eupithecia spermaphaga*. The only parasite listed is *Bracon* n.sp. near *tachypteri*. Descriptions of each insect and damage caused are included in the bulletin.
KEYW Cone insects, seed insects, *Conophthorus, Dioryctria, Eupithecia.*

312 AUTH Kellogg, R. M., Rowe, S., Koeppen, R. C., Miller, R. B.
DATE 1982
TITL Identification of the wood of the soft pines of Western North America.
PUBL IAWA Bulletin (New Series). 3: 95-101.
ABST A method is described for identifying the woods of the soft pines of Western North America: western white pine, sugar pine, limber pine, and whitebark pine.
KEYW Wood identification, resin canals.

313 AUTH Kemp, P. D., Metcalf, M. E.
DATE 1948

TITL Tables for approximating volume growth of individual trees.
PUBL Paper 11. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 14 p.
ABST These growth tables were derived from average-height volume tables. Application of these tables requires only a diameter determination and a radial growth measurement, either (1) number of annual rings in the outer radial inch or (2) the number of years (rings) in a specified radial increment in inches. Field checks show that the growth of single trees can be determined from the tables within 15 percent of a precise determination two out of three times. The tables express volume growth in three ways: (1) Annual board-foot (Scribner) growth of trees by diameter class and radial increment. (2) Average annual board-foot (Scribner) growth percent of trees by diameter class and radial increment. (3) Periodic (10 years) board-foot (Scribner) growth of trees by diameter class and radial increment. To facilitate the determination of growth of trees differing in diameter from the midpoint of the class and for growth rates between those indicated, the growth should be plotted over d.b.h. and curved in ordinary cross-section paper. This will not give a precise determination for the individual tree; nevertheless, the curved volumes and tables permit useful approximations of the volume growth of individual trees.
KEYW Volume growth.

314 AUTH Kempff, G.
DATE 1923
TITL Some results of winter slash disposal.
PUBL Applied Forestry Note 41. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Gives results of a test of progressive winter slash disposal in the western white pine type. Winter disposal of slash was shown to be an absolutely safe operation as a fire protective measure. Silviculturally, it was advantageous because less ground cover was burned. Damage to reproduction and reserved trees was held to a minimum. However, financially the method was not economical in this test. Suggestions are given for reducing costs.
KEYW Slash disposal winter.

315 AUTH Kendell Snell, J. A., Brown, J. K.
DATE 1978
TITL Comparison of tree biomass estimators—d.b.h. and sapwood area.
PUBL Forest Science. 24(4): 455-457.
ABST Investigation of 108 small trees ranging in d.b.h. from 0.5 to 19.3 cm for seven western conifer species in western Montana and northern Idaho revealed that, for some species, sapwood cross-sectional area can estimate crown biomass more precisely than external measurements, such as d.b.h.
KEYW Crown weight, biomass, sapwood area.

316 AUTH Kendell Snell, J. A., Brown, J. K.
DATE 1980
TITL Handbook for predicting residue weights of Pacific Northwest conifers.
PUBL General Technical Report PNW-103. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 44 p.
ABST Procedures are given for estimating weights of potential residue from Douglas-fir and western hemlock created by forest management activities west of the summit of the Cascade Range. Preliminary estimates are given for six other species, including western white pine.
KEYW Biomass, residue weights, weight tables.

317 AUTH Kennedy, J.
DATE 1964
TITL Tree planting in the Upper Hunter District.
PUBL Forest and Timber, Sydney. 1(4): 2-5.
ABST It is recommended that reforestation be increased in the Upper Hunter District to help stabilize present erosion and general catchment deterioration. Tree species already successfully established are listed for each of the three areas comprising the District.
KEYW Overgrazing, erosion, streambank stabilization, erosion control, reforestation.

318 AUTH Kennedy, P. C., Fellin, D. G.
DATE 1969
TITL Insects affecting western white pine following direct seeding in northern Idaho.
PUBL Research Note INT-106. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Insect damage to direct-seeded western white pine on three clearcut areas that were prescribed burned in successive years was investigated in north-central Idaho. Ground beetles ate seeds and grasshoppers and cutworms ate seedlings in the field and in the laboratory. The amount of damage to seedlings was inversely related to the age of the burn. Insects only slightly restricted successful first-year development of western white pine following direct seeding.

KEYW Direct seeding, ground beetles, grasshoppers, cutworms.

319 AUTH Ketcham, D. E., Wellner, C. A., Evans, S. S., Jr.
DATE 1968
TITL Western white pine management programs realigned on Northern Rocky Mountain National Forests
PUBL Journal of Forestry. 66: 329-332.
ABST A comprehensive evaluation of problems of managing western white pine stands in National Forests in the Northern Rocky Mountains completed in 1966 led the U.S. Forest Service to realign its management of this and associated species. Comparative reduction in economic importance of western white pine, coupled with inability of blister rust control programs to protect white pine, strongly influenced the Federal management decision.
KEYW Management, economic importance, protection.

320 AUTH Kidd, F. A., Miller, D. L.
DATE 1983
TITL The effects of Tordon herbicide on planted conifer seedlings.
PUBL Forest Technical Paper TP-83-1. Lewiston, ID: Potlatch Corporation. 6 p.
ABST Picloram, the active ingredient in the herbicide Tordon 101, will injure conifer seedlings planted soon after application. This test evaluated the delay required between spraying and planting in volcanic ash soil to avoid damage on Douglas-fir, white pine, and ponderosa pine seedlings. Two rates of Tordon 101 were applied in early and late summer. Survival and growth of planted seedlings were not affected by Tordon 101. Picloram concentration found at soil depths of 0-6 and 6-12 inches at time of planting was insufficient to cause injury. Foliar concentrations after one growing season were below detectable limits and resulted only in slight needle curl in Douglas-fir.
KEYW Herbicides, Tordon.

321 AUTH Kidd, F. A., Miller, D. L.
DATE 1983
TITL Swamp Creek herbicide screening - second season results.
PUBL Forest Research Note RN-83-6. Lewiston, ID: Potlatch Corporation. 11 p.
ABST Efficacy of selected rates and timing of application for various herbicides was evaluated for northern Idaho brush species and conifers. Garlon 4, Roundup, Tordon 101, and 2,4-D were aerially applied to twenty-three test plots in 1981. Early foliar (late June) applications resulted in the greatest topkill and cover reduction of brush, but also caused the most defoliation of conifers. Roundup (2 qt ai/acre), Garlon 4 (3 qt ai/acre + 3 qt Diesel adjuvant), and Tordon 101 + 2,4-D (1 gal + 2 lb ai/acre) were all effective for brush control. Late summer applications (late August) were slightly less effective for brush control, but damage to conifers was reduced.
KEYW Herbicides, Garlon, Roundup, Tordon, 2, 4-D.

322 AUTH King, J. P.
DATE 1971
TITL Some proposals for breeding weevil-resistant white pine.
PUBL Paper presented at: International Union of Forest Research Organizations 15th Congressional Proceedings. 9 p.
ABST Breeding a variety of eastern white pine (*Pinus strobus*) that is resistant to attack from the white-pine weevil (*Pissodes strobi*) is made difficult by the relatively small amount of variation in resistance within this species of white pine. This paper suggests interspecific hybridization of *P. strobus* with *P. monticola* and *P. peuce* as a means of increasing the resistance variation and offers some proposals for developing a more effective breeding program.
KEYW Weevil resistance, *Pinus strobus* x *P. monticola*, hybrids, insect resistance.

323 AUTH Kirk, T. K., Highley, T. L.
DATE 1973
TITL Quantitative changes in structural components of conifer woods during decay by white- and brown-rot fungi.
PUBL Phytopathology. 63: 1338-1342.
ABST Quantitative changes in lignin, glucan, mannan, and xylan during decay of five conifer woods by three white-rot and three brown-rot fungi were determined. (Glucan, mannan, and xylan provided estimates of cellulose and the hemicelluloses galactoglucomannan and aragino-4-0-methylglucuronoxylan, respectively.) All the white-rot fungi removed all the major wood components progressively during decay; the brown-rot fungi removed the polysaccharides but not lignin. The white- and brown-rot fungi removed the mannan and usually xylan faster than glucan, but the difference was not as pronounced for the white-rot as for the brown-rot organisms. The brown-rot fungi all had similar effects on the chemical composition of all the woods. In the white-rot type of decay, there was variation in the effects on the chemical composition; this appeared to depend more on the wood being decayed than the fungus involved.

KEYW *Polyporus versicolor, Ganoderma applanatum, Peniophora, Poria monticola, Lensites trabea, Lentinus lepideus,* white rot fungi, brown stain.

324 AUTH Koch, E.
DATE 1926
TITL The future of forest lands in Montana and Idaho.
PUBL Journal of Forestry. 24: 518-532.
ABST The author issues a warning that cutting practices are too intensive to support the present timber industry. He foresees much road building and intensive silviculture.
KEYW Timber production, timber needs, timber depletion.

325 AUTH Koch, E.
DATE 1937
TITL Function of National Forest timber in Idaho white pine region.
PUBL Forestry News Digest. 37(6): 21-22.
ABST The author states that the lumber industry of the Idaho white pine region is largely built on pine, and when the pine is gone the industry is gone. He predicts that at the present rate (1937), the majority of the mills will be shut down within 10 to 12 years due to excess cutting on private lands.
KEYW Lumber supply, sustained yield.

326 AUTH Koch, E., Cunningham, R. N.
DATE 1927
TITL Timber growing and logging practice in the western white pine and larch-fir forests of the Northern Rocky Mountains.
PUBL Bulletin 1494. Washington, DC: U.S. Department of Agriculture, Forest Service. 38 p.
ABST The western white pine type is discussed in terms of its general character, logging practices, fire control, slash disposal, thinning, cutting methods, planting, and disease control. The practicality of growing white pine timber is discussed in terms of growth and yield, and the costs involved in growing the timber. Desirable forest practices are presented throughout the paper.
KEYW Silvicultural methods, white pine type.

327 AUTH Koenigs, J. W.
DATE 1966
TITL Studies of cytochemical localization of specific dehydrogenases in frozen, diseased tissues of *Pinus*.
PUBL American Journal of Botany. 53: 1101-1108.
ABST Intracellular activity of individual dehydrogenases in frozen tissues of *Pinus monticola* and *Cronartium ribicola* was demonstrated by supplying a specific substrate and the appropriate pyridine-nucleotide-linked coenzyme. Freezing broke cell-permeability barriers, releasing endogenous coenzymes and substrates which had produced nonspecific enzymatic reduction of nitro blue tetrazolium by miscellaneous dehydrogenases throughout fresh tissues.
KEYW Cytochemistry, dehydrogenase, diseased tissue, frozen tissue, tetrazolium cytochemistry.

328 AUTH Kotak, E. S.
DATE 1973
TITL Western white pine—an American wood.
PUBL FS-258. Washington, DC: U.S. Department of Agriculture, Forest Service. 6 p.
ABST Western white pine is "king of the pines" in the Inland Empire, that portion of northern Idaho, western Montana, eastern Washington, and interior British Columbia lying between the Pacific Coastal Ranges and the Rocky Mountains. It is generally the tallest, straightest, and most important commercial species within its range. Its wood has been valued, along with the other white pines, for a great many lumber and related products where light color, ease of working with tools, straightness of grain, and fine texture are especially prized. At one time, western white pine was the principal species used for wooden matches. It is now (1973) being used extensively for plywood and pulp.
KEYW Uses.

329 AUTH Krasjina, V. J.
DATE 1955
TITL Transpiration and shade-tolerance of trees.
PUBL Bulletin of the Ecology Society of America. 36(2): 51.
ABST States that *P. monticola* is shade-intolerant in certain humid regions, whereas it may become shade-tolerant in relatively drier areas.
KEYW Transpiration, shade tolerance.

330 AUTH Kriebel, H. B.
DATE 1959
TITL Current research in forest tree improvement at the Ohio Agricultural Experiment Station.
PUBL In: Proceedings, 6th meeting of Canadian Forestry Tree Breeding Committee. 1958. p. q3-q5
ABST Grafting of soft pines on *Pinus strobus* included the following species and cultivars: *P. koraiensis, P. parviflora, P. parviflora pentaphylla, P. flexilis, P. griffithii, P. peuce, P. strobus, P. strobus fastigioata, P. cembra, P. monticola, P. armandii,* and *P. ayacahuite.* Several clones of each species were being propagated. A breeding arboretum was to be started in 1959.

KEYW Grafts on *Pinus strobus*.

331 AUTH Kriebel, H. B., Fowler, D. P.
DATE 1965
TITL Variability in needle characteristics of soft pine species and hybrids.
PUBL Silvae Genetica. 14: 73-76.
ABST Some needle characters of species and hybrids of soft pines are described, including number of serrulations on the axial margin, position and number of rows of stomata, position of resin canals, number of resin canals, and thickness of hypodermal cell walls. The studies showed that there is more genetic variability within the various taxa than was indicated by earlier investigations. Moreover, certain characters vary with the age of the tree or with the part of the needle that is sampled.
KEYW Needle characteristics, *Pinus monticola* x *P. ayacahuite*, *Pinus monticola* x *P. peuce*, *Pinus monticola* x (*P. peuce* x *strobus*), *Pinus monticola* x *P. strobus*, *Pinus monticola* x *P. griffithii*, hybrids-needle characteristics.

332 AUTH Kruckeberg, A. R.
DATE 1964
TITL Interrelations between plant distribution and soil type.
PUBL Proceedings, 10th Annual Botanical Congress. p. 13-14.
ABST Describes plant life on serpentines and other ultramafic rocks in northwestern North America. Where ultramafic rocks such as serpentine, peridotite, and dunite outcrop in Oregon, Washington, and British Columbia, the vegetation often contrasts markedly with that on adjacent but different rock types. The *Tsuga heterophylla-Thuja plicata* and the *Pseudotsuga menziesii-Pinus ponderosa* forest types may give way to stunted, sparse stands of *Pseudotsuga menziesii*, *Pinus monticola*, *P. contorta*, and *Juniperus communis*. The response of vegetation to ultramafic rocks takes various forms: (1) dwarfing, lowered abundance, or altitudinal extensions of regional coniferous species; (2) omission of many of circumjacent nonultramafic species (a depauperized flora on ultramafics); (3) widespread discontinuous occurrence on ultramafics of two ferns; (4) "pioneer"-type community with much bare ground; and (5) occurrence of few but distinctive endemic species on some ultramafic outcrops.
KEYW Soil type, distribution.

333 AUTH Krugman, S. L., Jenkinson, J. L.
DATE 1974
TITL Seeds of woody plants in the United States—*Pinus*.
PUBL Agriculture Handbook 450. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 598-638.
ABST For *Pinus monticola*, the following information is given: Local variations with elevation and site are recognized. Progenies from high-elevation origins grow faster at high elevations than those from low-elevation origins. Seeds from northern Idaho are smaller than those from Washington and California. Other information is contained in several tables.
KEYW Seeds.

334 AUTH Kuijt, J.
DATE 1956
TITL A new record of dwarf mistletoe on lodgepole and western white pine.
PUBL Madroño. 13: 170-172.
ABST A single small tree of western white pine near Horne Lake, Vancouver Island, BC, was found to bear dwarf mistletoe shoots protruding from fusiform to spherical swellings on the branches and main stem. The lodgepole pine overstory was heavily infected with *Arceuthobium campylopodum*.
KEYW Dwarf mistletoe, *Arceuthobium campylopodum*.

335 AUTH Kulhavy, D. L., Chacko, R. J., Partridge, A. D.
DATE 1978
TITL Some decay and disease fungi isolated from western white pine in northern Idaho.
PUBL Plant Disease Reporter. 62(4): 332-336.
ABST Isolations from stems and roots of standing western white pine indicate disease fungi are common throughout the range of this species in northern Idaho. The most common stem pathogens were *Fomes pini*, *Stereum sanguinolentum*, *Armillaria mellea*, and *Polyporus schweinitzii*. The most common root pathogens were *A. mellea*, *P. schweinitzii*, and *Odontia bicolor*. Four species of *Verticicladiella*, *V. wagenerii*, *V. antibiotica*, *V. penicillata*, and *V. abietina*, were isolated from white pine, the latter three for the first time.
KEYW Stem diseases, root diseases.

336 AUTH Kutney, J. P., Eigendorf, G., Swingle, R. B., Knowles, G. D., Rowe, J. W., Nagasampagi, B. A.
DATE 1973
TITL Novel triterpenes from western white pine (*Pinus monticola* Dougl.) bark.
PUBL Letter 33. Pergamon Press, Great Britain Tetrahedron. p. 3115-3118.
ABST After a preliminary investigation of the chemistry of western white pine bark, a more detailed study of the benzene extract was undertaken. A total of 90 terpenoids

were isolated, including 34 triterpenes. These include 24-methylene-cycloartanol, 10 known and 10 new serratanes, and 11 new triterpenes that appear to have a common skeleton. The two major components of this last group are a methoxydiol and a triol which comprise 0.7 and 0.2 percent of the benzene extract, respectively.

KEYW Triterpenes.

337 AUTH Kutney, J. P., Eigendorf, G., Worth, B. R., Rowe, J. W., Conner, A. H., Nagasampagi, B. A.

DATE 1981

TITL New triterpenes from the bark of western white pine (*Pinus monticola* Dougl.).

PUBL Helvetica Chimica Acta. 64(4), No. 111: 1183-1207.

ABST Eleven new triterpenes with the lanostene-type skeleton were isolated from benzene extract of western white pine bark. Their structures were determined mainly on the basis of physical and spectral data.

KEYW Triterpenes.

338 AUTH Lambeth, C. C.

DATE 1980

TITL Juvenile-mature correlations in Pinaceae and implications for early selection.

PUBL Forest Science. 26: 571-580

ABST Juvenile-mature correlations in the literature were analyzed and found to be more predictable than may have been expected by those who have dealt with them. Age-age correlations except those involving very young ages, usually 1 to 3 years, can be estimated with reasonable accuracy by a single regression equation which applies to several species and studies. Applicability of the equation to genetic test situations may be possible. After predicting age-age correlations, optimum selection age was estimated for several economic rotations. These ages for 30- and 40-year economic rotations were 6 and 8 years, respectively, for the conditions specified.

KEYW Age-age correlations, early selection, gain per year.

339 AUTH Landry, P. P.

DATE 1976

TITL Taxinomie tridifferenteille de *Pinus stobus* L. et de *Pinus monticola* Dougl.

PUBL Bulletin of the Botanical Society of France. 123: 47-60.

ABST Up to now, dendrologists have individually given at most one or two neat differences, without overlapping, between *Pinus strobus* and *P. monticola,* giving the impression that these two taxons were perhaps not specifically distinct. The author, after making a review of the extant literature on this subject, compares seven morphological characters and he concludes that four of them are neatly different:the kind of hairiness on the twigs, the number of fertile scales per cm of length of the female cones, and the shape of the cracks on the bark of older trees. It is concluded that the taxons are specifically distinct. A complete taxonomic documentation is given of both species as found in natural habitats, including three subspecific taxons, *P. strobus* var. *prostrata, P. monticola* var. *minima,* and *P. monticola* f. *porphyrocarpa.*

KEYW Taxonomy, morphological characters, *Pinus monticola* var. *minima, Pinus monticola* f. *porphyrocoppa.*

340 AUTH Larsen, J. A.

DATE 1918

TITL Comparison of seed testing in sand and in the Jacobsen germinator.

PUBL Journal of Forestry. 18: 690-695.

ABST The author compared germination in sand with germination in the Jacobsen germinator for nine conifer species. Results for *P. monticola* were: percent germination after 32 days - sand 18.5 percent, germinator 22.0 percent; percent per day of most rapid germination - sand 1.2, germinator 2.0; days required for complete germination - sand 200, germinator not completed.

KEYW Seed germination, seed testing, Jacobsen germinator, germinating medium.

341 AUTH Larsen, J. A.

DATE 1918

TITL Growth of western white pine and associated species in northern Idaho.

PUBL Journal of Forestry. 16: 839-840.

ABST Early data from sample plots at Priest River Experimental Forest, ID, are summarized. The most significant fact brought out is the remarkable growth of western white pine, which in this instance adds 1,095 bd ft per acre per year, followed by Douglas-fir at 879 bd ft and ponderosa pine with 745 bd ft. The data show an actual increase of 9.1 percent for white pine, 7.2 for yellow pine, 11.9 for Douglas-fir, and 5.6 percent for larch.

KEYW Annual growth, yield, annual growth comparison, *Larix occidentalis, Pseudotsuga menziesii, Pinus ponderosa.*

342 AUTH Larsen, J. A.

DATE 1921

TITL Germination of seed in the duff under western white pine stands.

PUBL District 1 Applied Forestry Note 22. Missoula, MT: U.S. Department of Agriculture, Forest Service. 3 p.

ABST Conclusions drawn from this study are: (1) The amount of white pine seed stored in the duff is dependent upon the number of white pine trees in the original stand and their seed productive capacity. (2) In old decadent stands of white pine, lesser results must be counted on from seed in the duff than from younger and more thrifty stands. (3) The preservation of the duff layer favors the restocking of white pine. (4) Burning of the duff layer destroys stored seed and eliminates the possibility of restocking except by reseeding or by planting.
KEYW Seed germination, duff, regeneration.

343 AUTH Larsen, J. A.
DATE 1922
TITL Effect of the removal of the virgin white pine stand upon the physical factors of site.
PUBL Ecology. 3: 302-305.
ABST Records kept during July and August showed the following differences between virgin forest stands and clearcut areas: air temperature, 10 degrees warmer in uncut forest at night and 10 degrees cooler during the hot part of the day; soil temperature, 4-5 degrees fluctuation in the clearcut area, only 1 degree in the uncut forest; evaporation is more than twice as great in the open as under timber; soil moisture is lower under timber than in the open. The author concludes that clearcutting renders a site precarious for the establishment of white pine seedlings.
KEYW Air temperature, humidity, soil temperature, soil moisture, clearcut air temperature, closed forest air temperature, clearcut soil temperature, closed forest soil temperature, clearcut soil moisture, closed forest soil moisture.

344 AUTH Larsen, J. A.
DATE 1922
TITL Some characteristics of seeds of coniferous trees from the Pacific Northwest.
PUBL National Nurseryman. 30: 246-249.
ABST Germination tests and observations on the character of seeds of coniferous trees native to Montana and northern Idaho showed that: (1) the seed is liable to serious injury by storage of the cones in wet conditions; (2) the extraction of the seed under temperatures above 120 °F and in such hot and very humid air reduces the viability of the seeds; (3) sterilization to prevent damping-off or bad molding is apt to injure seed of small, thin seed coats; (4) the rate of germination of seeds which ordinarily germinate slowly may be hastened materially by reduction of the impervious seed coat; and (5) coniferous seeds often remain viable in dry storage from 8 to 10 years.
KEYW Seeds, seed characteristics, seed extraction, seed germination, seed storage, delayed germination.

345 AUTH Larsen, J. A.
DATE 1923
TITL Another thought on slash disposal in western white pine stands.
PUBL Applied Forestry Note 36. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 2 p.
ABST Stresses that no one method of slash disposal may be used under all circumstances. Diverse field conditions necessitate different methods. Slash burning in piles, in windrows, broadcast, forced burning, burning in different seasons, at night, and under different climatic conditions have all been tried. The author suggests that man's originality and ingenuity are the greatest needs.
KEYW Slash disposal, slash burning.

346 AUTH Larsen, J. A.
DATE 1923
TITL Association of trees, shrubs, and other vegetation in the northern Idaho forests.
PUBL Ecology. 4: 63-67.
ABST The author classifies the forests of northern Idaho into four altitudinal belts or forest types: western yellow (ponderosa) pine; western larch—Douglas-fir; white pine, cedar, hemlock, and lowland white fir; and subalpine (mountain hemlock, alpine fir, Engelmann spruce, and lodgepole pine). He lists associated vegetation for all but the subalpine type.
KEYW Vegetation classification, habitat type.

347 AUTH Larsen, J. A.
DATE 1924
TITL Natural reproduction on single and double burns in northern Idaho.
PUBL Applied Forestry Note 52. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Natural reproduction after a single burn on three strips was comprised of 44 percent, 36 percent, and 53 percent western white pine. After double burns, only larch and white fir survived at all. It is evident from these data that natural reproduction comes in fairly abundantly after single fires, and only scantily or not at all after a second fire. Results indicate that south and west slopes should be the first to be planted.
KEYW Natural reproduction, single burn, double burn.

348 AUTH Larsen, J. A.
DATE 1924
Some factors affecting reproduction after logging in northern Idaho.
PUBL Agricultural Research. 28: 1149-1157.
ABST Large openings made in the forest cover by clearcutting cause increase in air and soil temperature, evaporation, and moisture deficit, which present unfavorable conditions for reestablishment of moisture-loving species. Furthermore, changed surface conditions resulting from large openings and vegetation on areas completely cleared may defeat natural regeneration altogether. Surfaces of ash and bare mineral soil when loose offer the most favorable conditions for rapid germination and establishment of seedlings provided seed is immediately available, but where overhead or adjacent trees must supply the seed for natural restocking over a period of years, a loose and protected surface such as is provided by needle duff and light vegetation is more favorable. The extremely high surface soil temperatures which occur on cleared and exposed flats and south slopes are injurious to establishment of seedlings of western white pine, cedar, and hemlock, and this explains the general scarcity of these species on sites exposed to sun and wind and the difficulty of restocking these after clearcutting on a large scale. A method of cutting which would provide smaller openings and partial shade or shelter would produce better silvicultural results.
KEYW Reproduction, seed germination, survival, seed beds, moisture, soil temperature aspect, soil.

349 AUTH Larsen, J. A.
DATE 1925
TITL Methods of stimulating germination of western white-pine seed.
PUBL Agricultural Research. 31: 889-899.
ABST The delayed germination of western white pine seed is due to the presence of an impermeable seed coat, not to any inherent physiological characteristics. Four methods to ensure prompt germination are discussed.
KEYW Seed stratification, seed scarification, seed ripening.

350 AUTH Larsen, J. A.
DATE 1925
TITL Natural reproduction after forest fires in northern Idaho.
PUBL Agricultural Research. 30: 1177-1197.
ABST Natural restocking on once and twice-burned areas was studied. Where a single fire destroyed a mature forest, the natural restocking has been prompt, uniform, and complete, with western white pine comprising a substantial portion of the reproduction. Timing of regeneration, storage of seed in the duff, and the influence of the character of the burn on reproduction are all discussed.
KEYW Seed distribution, seed germination, succession, fire.

351 AUTH Larsen, J. A.
DATE 1925
TITL Products from immature white pine stands in Idaho.
PUBL Idaho Forester. 7: 15-16, 45.
ABST A medium thinning in a 1.5-acre plot produced 987 ft^3 (white pine, Douglas-fir, larch, ponderosa, and lodgepole pine), used as mining stulls (24), railroad ties (13), fenceposts (191), mining props (17), fence rails (14), bucket stock (300), and cordwood (9.7 ft^3).
KEYW Products from thinning, thinning.

352 AUTH Larsen, J. A.
DATE 1927
TITL Relation of leaf structure of conifers to light and moisture.
PUBL Ecology. 8: 371-377.
ABST Comparisons of leaf structure of coniferous trees with respect to different requirements for moisture and light are tabulated for several coniferous species.
KEYW Leaf structure, light, moisture, shade tolerance.

353 AUTH Larsen, J. A.
DATE 1929
TITL Fires and forest succession in the Bitterroot Mountains of northern Idaho.
PUBL Ecology. 10: 67-76.
ABST When the cedar-hemlock-grand fir forest in the Bitterroot Mountains is destroyed by fire, the forest returns to its climax composition through a series of associations occurring in regular succession. Forest zones and silvical requirements of the trees are discussed, and their relative requirements for light, moisture, and soil fertility are presented. Principal species found in each major association are listed.
KEYW Plant sociology, succession, fire.

354 AUTH Larsen, J. A.
DATE 1930
TITL Forest types of the Northern Rocky Mountains and their climatic controls.
PUBL Ecology. 11: 631-672.
ABST The natural distribution and chief silvical and climatic characteristics of the natural

forest types of the Northern Rocky Mountains in Montana and Idaho are discussed. The western white pine type is among those described in detail.

KEYW Relative species tolerance, tolerance.

355 AUTH Larsen, J. A.
DATE 1940
TITL Site factor variations and responses in temporary forest types in northern Idaho.
PUBL Ecological Monographs. 10: 1-54.
ABST Air temperature relations show higher daily and seasonal maximums on the southwest aspect with a longer duration of temperatures favorable for growth than at the other points. The minimums of the air temperatures were lowest on the flat both winter and summer and highest on the northeast slope. Soil temperatures reflect and follow the trend of the air temperatures, but diverge far more at the surfaces and in the upper soil stratum than at the lower levels. The southwest aspect is characterized by a shallower snow cover, which is also of shorter duration than on the other sites. The soil moisture reaches more critical minimums and remains at dangerously low points for extended periods in summer, and wind movement and evaporation are more pronounced than elsewhere. The soils on the northeast slope and where the mesic species grow contain a greater clay and silt fraction and higher capillary and other moisture-retaining qualities than those occupied by the xerophytic western yellow (ponderosa) pine. Soils of the more sandy flats which become occupied with larch and Douglas-fir are ordinarily not sufficiently improved in physical properties to favor the growth of western white pine, cedar, and hemlock. Seedlings raised from seed from the different sites expressed, by their germination during the first two seasons and by their survival and height growth to the end of the fifth year, a conformity to the already existing forest trees which had seeded in after the forest of 60 years ago.
KEYW Site factor variation, planting tests, climate, edaphic factors, seedling survival.

356 Deleted.

357 AUTH Larsen, J. A., Lowdermilk, W. C.
DATE 1924
TITL Slash disposal in western white pine forests in Idaho.
PUBL Circular 292. Washington, DC: U.S. Department of Agriculture. 20 p.
ABST Broadcast burning in the white pine type does not meet the requirements of fire protection or of silviculture. The method of piling and burning is valuable in reducing the fire hazard, while preserving favorable site conditions.
KEYW Broadcast burning, fire protection, piling and burning, site conditions.

358 AUTH Larsen, J. A., Stump, W. G.
DATE 1939
TITL Some experiments with fertilizers for evergreen seedlings.
PUBL Journal of Science. Ames, IA: Iowa State College; 13: 293-305.
ABST This paper presents the results of fertilizer tests conducted on several species of nursery stock including white pine. The same reagents are noted to produce different results in the various species. In general, the use of nitrogen fertilizers increased top growth; those containing phosphorus increased root development. In the nursery, a combination of fertilizers containing N, P, and K was usually more effective than a single treatment of only one element. In the greenhouse tests, single elements proved more effective.
KEYW Fertilizer, root growth, top growth, seedlings, greenhouse, nursery.

359 AUTH Leaphart, C. D.
DATE 1956
TITL Physiological studies of some fungi associated with pole blight of western white pine.
PUBL Mycologia. 48(1): 25-40.
ABST Physiological requirements are reported for five fungal isolates commonly associated with pole blight of western white pine. Four of the isolates belonged to the genus *Leptographium;* the fifth was *Ceratocystis pilifera.* Parameters studied included temperature, pH, and vitamin requirements, and carbohydrate and nitrogen utilization.
KEYW *Leptographium, Ceratocystis pilifera*, pole blight.

360 AUTH Leaphart, C. D.
DATE 1958
TITL Pole blight—how it may influence western white pine management in light of current knowledge.
PUBL Journal of Forestry. 56: 746-751.

ABST Summarizes current knowledge of pole blight. Indicates that no specific cause has yet been determined for the disease, except perhaps climatic conditions. No fungus, virus, or primary insect has been identified as the cause of rootlet deterioration present in blighted trees.

KEYW Pole blight, rootlet deterioration, climate.

361 AUTH Leaphart, C. D.
DATE 1958
TITL Root characteristics of western white pine and associated tree species in a stand affected with pole blight of white pine.
PUBL Research Paper 52. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 10 p.
ABST Data were collected on the Priest River Experimental Forest in northern Idaho from a 1-acre area in a white pine stand where pole blight was first observed in 1941. Data include: species stand table showing number of stems and basal area per acre and percentage of trees in the dominant and codominant crown classes; ratio of rootlet length to length of parent lateral root, root tips per rootlet; and average rootlet and root tip mortality of tree species. The authors conclude that the climax species appear to be well adapted to compete for available moisture in the pole blight area under study. Western redcedar may be the most effective competitor. Climax species' roots of all diameters with their attached rootlets occupy the soil area much more completely than the subclimax group. White pine must transport water for greater distance since it has a greater structural root length than the other species except possibly grand fir and spruce. This study suggests that if other factors were constant and equal for all species, western white pine, because of its less profuse fine root system, would not be able to compete as efficiently for water and mineral uptake as other species within pole blight areas.
KEYW Root characteristics, pole blight, lateral root length, root tips, root mortality, root distribution, root length.

362 AUTH Leaphart, C. D.
DATE 1959
TITL Drought damage to western white pine and associated tree species.
PUBL Plant Disease Reporter. 43: 809-813.
ABST An unusually dry summer in 1958, characterized by abnormally high temperatures, damaged western white pine, western larch, grand fir, and lodgepole pine in an area in northeastern Washington and northern Idaho. Damage ranged from foliage wilting to death of trees, and affected trees from 3 to 25 ft tall.
KEYW Drought, drought injury, *Larix occidentalis, Abies grandis, Pinus contorta*.

363 AUTH Leaphart, C. D., Copeland, O. L., Jr.
DATE 1957
TITL Root and soil relationships associated with the pole blight disease of western white pine.
PUBL Soil Science Society of America Proceedings. 21(5): 551-554.
ABST Root density and mortality were determined in 30 healthy western white pine stands ranging from 20 to 160 years old. Similar determinations were made in 16 stands of the 60- to 80-year age class affected by pole blight, a disease of unknown cause. Various physical soil characteristics were measured in 26 healthy and diseased stands in conjunction with the root study. Both rootlet mortality and density in the upper 1 ft of soil are significantly correlated with the available water storage capacity in the soil depth occupied by a major portion of the root system. The available water storage capacity is dependent upon effective soil depth. As the severity of pole blight increases, rootlet mortality increases and available water storage capacity and effective soil depth become less. These results indicate an edaphic relationship to the pole blight disease.
KEYW Pole blight, soil.

364 AUTH Leaphart, C. D., Copeland, O. L., Jr., Graham, D. P.
DATE 1957
TITL Pole blight of western white pine.
PUBL Forest Pest Leaflet 16. Washington, DC: U.S. Department of Agriculture, Forest Service. 4 p.
ABST Gives a general description of pole blight including its distribution, importance, and symptoms. No cause or method of control has been discovered.
KEYW Pole blight.

365 AUTH Leaphart, C. D., Foiles, M. W.
DATE 1972
TITL Effects of removing pole-blighted western white pine trees on growth and development of a mixed conifer stand.
PUBL Research Note INT-161. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST A mixed conifer stand, in which western white pine was infected with the pole blight disease, was treated by removing either (a) all blighted trees, or (b) merchantable

blighted trees. Neither treatment significantly altered the development of pole blight in the residual stand for 17 years following the cutting. The Douglas-fir component suffered heavy mortality, caused mostly by *Poria weirii* root rot; therefore, it had negative net growth for the period. Western redcedar, the predominant understory conifer, responded well to release and accounted for much of the basal area and cubic volume increment.

KEYW Pole blight, cleaning stand, *Pseudotsuga menziesii, Poria weirii, Thuja plicata.*

366 AUTH Leaphart, C. D., Gill, L. S.
DATE 1955
TITL Lesions associated with pole blight of western white pine.
PUBL Forest Science. 1(3): 232-239.
ABST This study indicates that reduced radial growth precedes both crown decline and lesion development in white pine afflicted with pole blight. Lesions are apparently not directly responsible for the progressive decline of diseased trees.
KEYW Pole blight, lesions, crown symptoms, radial growth.

367 AUTH Leaphart, C. D., Gill, L. S.
DATE 1959
TITL Effects of inoculations with *Leptographium* spp. on western white pine.
PUBL Phytopathology. 49: 350-353.
ABST Seven isolates of *Leptographium* were used in several series of inoculations on healthy western white pine trees. About 2,300 inoculations, involving different techniques of wounding and several types of inoculum, were made on different portions of the roots and stems of 321 trees during a 3-year period. All isolates caused some degree of cambial necrosis, but differences in virulence were observed. Definite callusing developed around the edges of nearly all lesions within 1 year of inoculations; fewer than three of the positive inoculations were still active 3 years later. The study suggests that: (1) the potential of this fungus to cause damage in healthy white pine trees is inversely proportionate to the tree's ability to callus diseased tissue; (2) the fungus contributes to the deterioration of the structural root systems of pole-blight-affected stands; and (3) the virulence of the form of *Leptographium* present in a diseased tree may be associated with both the lesion development pattern on the tree and that tree's rate of decline.
KEYW *Leptographium*, cambial necrosis, virulence, artificial inoculation, roots.

368 AUTH Leaphart, C. D., Hungerford, R. D., Johnson, H. E.
DATE 1972
TITL Stem deformities in young trees caused by snowpack and its movement.
PUBL Research Note INT-158. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 10 p.
ABST After felling and burning, 4-year-old *Pinus monticola* seedlings were planted on north-facing slopes (mean slope 50 percent) at 3,660 to 4,560 ft altitude in northern Idaho in 1959. Subsequent natural regeneration resulted in mixed conifer stands with a mean height of 4.0-4.5 ft in 1968. In a sample of 410 trees (76 percent of which were deformed), six classes of stem deformity were observed, the most common of which was butt sweep. Virtually all the deformities originated within 5 ft of the ground and are attributed to the effects of snow load or movements of the snowpack; many of the taller trees had two or more deformities, and similar deformities were also observed in 40- to 80-year-old stands in the region. The results of the study indicate that the fastest growing species (*P. monticola* and *Larix occidentalis*) are least likely to suffer multiple deformity.
KEYW Injury, snow, stem form, crook, sweep.

369 AUTH Leaphart, C. D., Johnson, H. E.
DATE 1973
TITL Pole blight: also a disease of western white pine plantations.
PUBL Plant Disease Reporter. 57: 948-951.
ABST The pole blight disease of western white pine results from a complex interaction of physiologically related factors. The disease had been found previously only in natural stands of its host between 35 and 150 years old. The authors found it for the first time in a plantation (34 years old since planting). Data suggest that the disease had started by the time the plantation was 22 years old. The implications of this finding in relation to management of white pine are also discussed.
KEYW Pole blight, plantations.

370 AUTH Leaphart, C. D., Stage, A. R.
DATE 1971
TITL Climate: a factor in the origin of the pole blight disease of *Pinus monticola* Dougl.
PUBL Ecology. 52: 229-239.
ABST Measurements of cores or disc samples representing slightly more than 76,000 annual rings from 336 western white pine trees were

compiled to obtain a set of deviations from normal growth of healthy trees that would express the response of these trees to variation in the environment during the last 280 years. Their growth was demonstrated to be a function of temperature and available moisture for the period of climatic record from 1912 to 1958. Extrapolating the relation of growth to weather to the long tree ring record of western white pine, we find that the period 1916-40 represents the most adverse growth conditions with regard to intensity and duration in the last 280 years. This drought, superimposed on sites having severe moisture-stress characteristics, triggered the chain of events which ultimately resulted in pole blight. If the unfavorable conditions for growth during 1916-40 do not represent a shift to a new climatic mean and if western white pine is regenerated only on sites with low moisture-stress characteristics, the probability is high that pole blight will not reoccur for many centuries in stands regenerated from this date on.

KEYW Climate, pole blight, tree rings.

371 AUTH Leiberg, J. B.
DATE 1897
TITL General report on a botanical survey of the Coeur d'Alene Mountains in Idaho during the summer of 1895.
PUBL Contributions of the U.S. National Herbarium. 5(1): 85.
ABST An early botanical survey of northern Idaho. The author describes the topography, drainages, climate, mineral deposits, agricultural capacity, grazing lands, water supply, forest resources, forest zones, and forest problems—insects, fire, and man. Many of the major habitat types are described. He puts the vegetation into four units: yellow pine, white pine, subalpine fir, and white-barked pine.
KEYW Botanical survey, *Pinus ponderosa, Pinus murrayana, Pinus albicaulis, Picea engelmannii, Abies concolor, Abies lasiocarpa, Larix occidentalis, Pseudotsuga menziesii, Thuja plicata, Tsuga pattoniana, Tsuga mertensiana, Taxus brevifola, Juniperus virginiana.*

372 AUTH Leiberg, J. B.
DATE 1899
TITL Present condition of the forested areas in northern Idaho outside the limits of the Priest River Forest Reserve and north of the Clearwater River.
PUBL U.S. Geological Survey 19th Annual Report. p. 373-386.
ABST The amount of acres, standing board feet, and the amount of timber destroyed by fire during the previous 38 years is tabulated for Idaho north of the Clearwater River.
KEYW Acres white pine, board feet standing timber, board feet destroyed by fire.

373 AUTH Leiberg, J. B.
DATE 1899
TITL The Priest River Forest Reserve.
PUBL U.S. Geological Survey 19th Annual Report. p. 217-252.
ABST A report of the Priest River area: topography, water supply, soil, forest conditions, aspect of forest, amount of available timber, soundness of timber, means of transportation of lumber, local demand for lumber, timber cutting, present condition of the forest fires, effect of fires on reproduction, agricultural land, mineral resources, and lists of species.
KEYW Priest River Experimental Forest, history.

374 AUTH Lemn, A. J., Klomparens, W., Moss, V. D.
DATE 1960
TITL Translocation and persistence of cycloheximide (acti-dione) in white pines.
PUBL Forest Science. 6: 306-314.
ABST The antifungal antibiotic cycloheximide (acti-dione) is absorbed by, persists in, and is translocated upward in pole-size western white pine. The antibiotic persists for at least 2 years in the trunk bark of western white pine treated by the basal stem method. Cycloheximide was applied only to the lower trunk area and later recovered from needles of unsprayed branches. Movement was through the water-conducting elements, for the antibiotic could be detected in xylem tissue both at and above the site of application but was never detected in bark (phloem) tissue above the treated area of the trunk. Cycloheximide was also found to be translocated to needles on untreated branches of eastern white pine.
KEYW Cycloheximide, acti-dione, persistence—antibiotics.

375 AUTH Liev, P. J., Kelsey, R. G., Shafizadeh, F.
DATE 1979
TITL Some chemical characteristics of green and dead lodgepole pine and western white pine.
PUBL Research Note INT-256. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST The chemical components and combustion characteristics of dead and live lodgepole pine and western white pine were determined. Except for small variations, the chemical composition and burning characteristics of sound dead wood were nearly identical to the corresponding live wood for

both species. Therefore, dead wood could be utilized as a source of chemicals, as fuel, and as a substitute for live timber in the manufacture of wood products.

KEYW Chemical components, combustion characteristics, dead trees, utilization of dead trees.

376 AUTH Lindstedt, G.
DATE 1949
TITL Constituents of pine heartwood.
PUBL Acta Chemica Scandinavica. 3: 1147-1152.
ABST The following constituents have been isolated from the heartwood of *Pinus monticola*: pinitol, l-arabinose, chrysin (5,7-di-hydroxyflavone), strobopinin (probably a c-methyl dihydroxyflavanone), tectochrysin (5-hydroxy-7-methoxyflavone), and pinosylvin monomethyl ether.
KEYW Heartwood constituents, chemical composition.

377 AUTH Loewenstein, H., Pitkin, F. H.
DATE 1963
TITL Response of grand fir and western white pine to fertilizer applications.
PUBL Northwest Science. 37: 23-30.
ABST Highly significant height growth increases developed during the second growing season after treatment. Compared with elongation prior to fertilization, these increases ranged as high as 286 percent for grand fir and 187 percent for white pine.
KEYW Fertilizer, plantation growth.

378 AUTH Lowdermilk, W. C.
DATE 1921
TITL The problem of the unmerchantable trees in the white pine stands.
PUBL District 1 Applied Forestry Note 13. Missoula, MT: U.S. Department of Agriculture, Forest Service. 4 p.
ABST Broadcast burning any cutover areas bearing a stand of unmerchantable trees, whether on land listed as agricultural or nonagricultural, cannot be considered a satisfactory measure from the protection viewpoint. The felling of such trees previous to burning is necessary.
KEYW Unmerchantable trees, broadcast burning.

379 AUTH Lowdermilk, W. C.
DATE 1921
TITL Seed.
PUBL District 1 Applied Forestry Note 12. Missoula, MT: U.S. Department of Agriculture, Forest Service. 2 p.
ABST The following seed characteristics are given for western white pine: 24,000-31,000 seeds per lb, 2 years to mature, 60 percent nursery germination, seeds ripen in August and are shed in September, youngest cone bearing age in nature is 15 to 20 years.
KEYW Seed germination, seed production, seed maturity, cone bearing age.

380 AUTH Lowdermilk, W. C.
DATE 1922
TITL An outline of slash disposal practice in District One.
PUBL District 1 Applied Forestry Note 32. Missoula, MT: U.S. Department of Agriculture, Forest Service. 5 p.
ABST Slash disposal is practiced for two reasons: (1) to reduce fire hazard, and (2) to favor natural restocking of the logged-off tract. Specifications are given for slash disposal for the following types: western yellow pine, lodgepole pine, western larch, Douglas-fir, and western white pine. Information is also given on 1922 costs (western white pine, $0.60 to $1.25 per thousand bd ft) and rate of decomposition (western white pine, 10 to 15 years).
KEYW Slash disposal, fire hazard.

381 AUTH Lutz, H. J., Chandler, R. F.
DATE 1951
TITL Observations on litter fall and foliage nutrient content of some Pacific Northwest tree species.
PUBL Journal of Forestry. 49(12): 914-915.
ABST Preliminary observations are presented for annual litter fall and foliage nutrient content of ten Pacific Northwest tree species. Species are compared for the relative amounts of nitrogen, phosphorus, potassium, calcium, and magnesium contained within their foliage. The soil-building potential of red alder and western redcedar are emphasized.
KEYW Annual litter fall, foliage nutrient content, nitrogen, phosphorus, potassium, calcium, magnesium, soil pH.

382 AUTH Lynch, D. W., Schumacher, F. X.
DATE 1941
TITL Concerning the dispersion of natural regeneration.
PUBL Journal of Forestry. 39: 49-51.
ABST Although individual seedlings of natural reproduction are not distributed at random on cutover areas, analysis of recently published data from the western white pine type shows a remarkable consistency in the proportion of stocked quadrats of different size.
KEYW Natural regeneration, regeneration dispersal.

383 AUTH Machanicek, J.
DATE 1967

TITL Quality determination of seeds with delayed germination by the viability of their embryos.
PUBL Communications Instituti Forestalis Cechosloveniae. 5: 89-97.
ABST Tests sponsored by the International Seed Testing Association were conducted to compare prescribed methods of viability determination with the method of germinating extirpated embryos. Results showed that (1) the germination test is not suitable for seed with shorter or longer seed dormancy, (2) biochemical test by staining with tetrazolium provides a rapid, reliable, and easily repeatable evaluation of seed quality, (3) germinating extirpated embryos appears to be convenient only for dormant seed.
KEYW Seed quality, delayed germination, embryo viability, tetrazolium staining.

384 AUTH Mack, R. N.
DATE 1971
TITL Pollen size variation in some western North American pines as related to fossil pollen identification.
PUBL Northwest Science. 45: 257-269.
ABST Discusses methods of differentiating fossil pollens of *Pinus ponderosa, P. monticola, P. flexilis*, and *P. albicaulis.*
KEYW Pollen size, fossil pollen identification, corpus breadth, size frequency distribution.

385 AUTH Mann, W. F., Jr., Musselman, L. J.
DATE 1979
TITL *Senna seymeria* parasitizes western conifers.
PUBL Economic Botany. 33: 338-339.
ABST Describes the growth of *Senna seymeria*, a higher plant (Scrophulariaceae) hemiparasite of conifers and hardwood tree species.
KEYW *Senna seymeria*, parasite.

386 AUTH Manzos, A. M.
DATE 1960
TITL Studying the pH of pollen of tree and shrub species.
PUBL Lesno ZH Arhangelisk. 3(4): 34-37.
ABST Tables show the pH at three stages during the postembryonic development of pollen (bud swelling, opening, and flowering) and also of mature pollen at intervals during storage in a desiccater at 2 °C. It was concluded that pH 4.7-7 indicated viable, whereas pH 7.4-8 indicated nonviable pollen.
KEYW Pollen, pH.

387 AUTH Marshall, R.
DATE 1927
TITL Influence of precipitation cycles on forestry.
PUBL Journal of Forestry. 25: 415-429.
ABST The climate of northern Idaho from 1675-1925, as revealed by stumps of western white pine trees, has exhibited distinct wet and dry periods varying from 20 to 40 years. The 20 years since the Forest Service was created appear to be the driest score of years in $2^1/_2$ centuries. Such cycles have a vital bearing on the practice of forestry.
KEYW Precipitation cycles, tree growth, fire protection, age class, growth curves, climate stand origin, growth and yield.

388 AUTH Marshall, R.
DATE 1928
TITL The life history of some western white pine stands on the Kaniksu National Forest.
PUBL Northwest Science. 2: 48-53.
ABST The paper presents detailed forest biographies of a few trees on the Kaniksu National Forest based on their annual rings. The effects of repeated fires, insects, and site are discussed briefly, and tables are given for age distribution in an all-aged stand, a several-aged stand, a river bottom white pine stand, and a two-aged stand for all species within each stand.
KEYW Life history, all-aged stand, several-aged stand, river bottom stand, two-aged stand, fire, insects, age class, fire history.

389 AUTH Marshall, R.
DATE 1928
TITL Natural reproduction in the western white pine type: progress report summarizing investigations to date.
PUBL RS-MR-102. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 72 p.
ABST Reports on Zon's (1915) study and his conclusion that 98 percent of all seed was produced on dominant and codominant trees in 1911, commenting that later observations bear out Zon's findings (in that only occasional intermediate western white pines bear cones and no records of cones on suppressed trees exist). Notes on mechanical injury and resulting flower induction in girdled hemlock included. Out of 322 trees of eight species, the only ones on area with good seed crops (1.25 years after girdling) were seven of 16 girdled hemlocks. An experiment in torch-girdling of western white pine for seed production was set up following inconclusive data of effect of 1926 fire injuries on cone production. Four groups of three trees were girdled by slow torch at Priest River Experimental Forest, but squirrels cut cones 2 days before tallying of yield.
KEYW Seed germination, intensity of burn, dispersal, wind velocity, wind firmness, fire

resistance, aspect, precipitation, temperature, *Larix occidentalis, Tsuga heterophylla, Thuja plicata, Pseudotsuga menziesii, Abies concolor.*

390 AUTH Marshall, R.
DATE 1931
TITL An experimental study of the water relations of seedling conifers with special reference to wilting.
PUBL Ecological Monographs. 1: 37-98.
ABST Water content of seedlings was measured for several species. Data were also taken on the decreasing water content as drying went on. Data were taken on the initial water-supplying power of the soil, as related to wilting and to the critical water content of the seedling tops.
KEYW Plant tissue water content.

391 AUTH Marshall, R., Averill, C.
DATE 1928
TITL Soil alkalinity on recent burns.
PUBL Ecology. 9: 533.
ABST The pH value in burned over areas ranged from 6.5 to 8.0. It was suggested that the alkalinity may contribute to the scarcity of reproduction during the first 2 or 3 years following large fires.
KEYW Soil alkalinity, fire, reproduction and soil alkalinity.

392 AUTH Martin, J. S., Bray, M. W.
DATE 1940
TITL Sulphate pulping of western white pine (*Pinus monticola*).
PUBL Paper Trade Journal. 3: 35-38. [Tappi. 3: 309-312.]
ABST The pulping qualities of western white pine were studied. In general, this species is readily reduced by the sulfate process for the production of strong and bleachable pulps of comparatively high yield and fairly satisfactory physical properties. While some of the strength properties of the pulps are slightly inferior to the average commercial product, the fibers possess excellent tensile strength and good felting quality.
KEYW Sulfate pulping, pulping, chemical analysis-pulpwood.

393 AUTH Martin, N. E.
DATE 1976
TITL Changes in amounts of soluble sugars in western white pine tissues in response to season and blister rust.
PUBL Proceedings, American Phytopathological Society. 3: 318.
ABST Samples of current, 1-, and 2-year needles were randomly collected from crowns of 12- to 16-year-old western white pines in the fall, spring, and summer. Trees with a girdling bole canker (about 50 percent of circumference) were compared with rust-free trees. Needle ages and seasons were responsible for quantity differences in all sugars. In all needle ages, raffinose was reduced to a trace, and stachyose disappeared in seasons of rapid growth. Bole infections did not affect needle sugars. Bark samples from bole cankers and noninfected bark from the same and from different trees were analyzed for soluble sugars and compared. Aecia-producing areas of cankers showed a depletion of each sugar in the season prior to spore production, but resumed the pattern found for other invaded and noninvaded samples in other seasons. All bark areas were identical in kinds of sugars found within each season.
KEYW Blister rust canker, fructose, glucose, sucrose, raffinose, stachyose, sugars, seasonal variation.

394 AUTH Mason, D. T.
DATE 1914
TITL Management of western white pine.
PUBL Society of American Foresters Proceedings. 9: 59-68.
ABST Some overall management guidelines for western white pine were given. From these guidelines, a sample marking plan for the Lolo Creek area on the Clearwater National Forest was shown.
KEYW Management, seed germination, silviculture, marking, slash disposal, species control.

395 AUTH Matsui, Z., Inoue, M.
DATE 1959
TITL The classification and ecological study of soft pine and its species planted in Hokkaido.
PUBL In: Annual Report, Hokkaido Forest Experiment Station, Japan. p. 17-26.
ABST Compares soft pines species native and exotic to Japan. Lists *P. monticola* as one of the best planting trees in the mild temperate zone of Japan, but not for the climates with colder winters.
KEYW Ecology, Japan.

396 AUTH Matzke, E. B., Hulbarn, R. L.
DATE 1942
TITL An analysis of the wood of the three commercial species of white pine.
PUBL Bulletin of the Torrey Botanical Club. 69(8): 573-582.
ABST The pits of ray parenchyma cells in contact with tracheids are described in detail for the three commercial white pine species: *Pinus strobus, P. lambertiana*, and *P. monticola.* In all features, both gross and microscopic,

P. monticola is intermediate between the other two, this conforming with the natural distributions.

KEYW Ray parenchyma pits, tracheid radial walls, ray crossing.

397 AUTH McCauley, K. J., Cook, S. A.
DATE 1980
TITL *Phellinus weirii* infestation of two mountain hemlock forests in the Oregon Cascades.
PUBL Forest Science. 26: 23-29.
ABST Root rot by *Phellinus weirii* was studied in two coniferous stands at 1,650 m elevation in central Oregon. The fungus forms circular areas that are rather devoid of trees at their margins and occupied by successively older vegetation centripetally. Number, species, age, and circumference at breast height of trees were obtained in transects of three infection centers per stand. Some trees escape death or are killed slowly. These "resistant" trees were discriminated by size and age from adjacent regrowth trees.
KEYW Root rot, *Phellinus weirii.*

398 AUTH McDonald, G. I., Hoff, R. J.
DATE 1969
TITL Effect of rooting mediums and hormone application on rooting of western white pine needle fascicles.
PUBL Research Note INT-101. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST Two treatments, hormone application and a medium containing forest soil, produced equal but independent rooting responses in needle bundles obtained from 2-year-old western white pine (*Pinus monticola*) seedlings. Apparent sources of variation in rooting response are discussed.
KEYW Rooting mediums, hormone application, rooting needle fascicles, Rootone.

399 AUTH McDonald, G. I., Hoff, R. J.
DATE 1970
TITL Resistance to *Cronartium ribicola* in *Pinus monticola*: early shedding of infected needles.
PUBL Research Note INT-124. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST Detailed analysis of symptom history provided information on the nature of resistance to *Cronartium ribicola.* In *Pinus monticola* seedlings, two independent and sequential resistance factors appeared to be operative in seedling populations obtained from phenotypically resistant parents, but only one of these factors was present in seedling populations derived from phenotypically susceptible parents.
KEYW Blister rust, rust resistance.

400 AUTH McHarg, C. K.
DATE 1923
TITL The practice of forestry on the Coeur d' Alene National Forest.
PUBL Idaho Forester. 5: 9-13.
ABST The author discusses forest management on the Coeur d'Alene National Forest. The topographic situation and resources are presented. He presents his view on working circles, regulations of cuts, problems with inferior species, forest sanitation, and planting.
KEYW Forest resource, age class, working circle, forest sanitation, slash disposal, planting.

401 AUTH McHarg, C. K., Kittredge, J., Preston, J. F.
DATE 1917
TITL Developments in the marking of western white pine (*Pinus monticola*) in northern Idaho.
PUBL Journal of Forestry. 15: 871-885.
ABST Discusses scientific background and management decisions involved in new marking rules for western white pine and gives the rules for the Coeur d'Alene National Forest.
KEYW Marking rules.

402 AUTH McKeever, D. G.
DATE 1942
TITL Direct seeding of western white pine using poisons for rodent control.
PUBL Research Note 18. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 6 p.
ABST Four areas, 11, 20, 50, and 97 acres in size, all on selected good sites in northern Idaho, have been direct-seeded with western white pine using a poisoning method for rodent control developed by the Fish and Wildlife Service. Third-year survivals of seedlings on the 11- and 50-acre areas, seeded in late October 1939, was 67 percent, and first-year survival on 97 acres seeded in October 1940 was 61 percent. The promising results from these tests indicate that large-scale sowings of this species on the better sites can be a practical and economical method of establishing reproduction.
KEYW Direct seeding.

403 AUTH McKenzie, H. L.
DATE 1942
TITL New species of pine-infesting Margarodidae from California and southwestern United

States (Homoptera: Coccoidea: Margarodidae).
PUBL Microentomology. 7(1): 1-24.
ABST Five new species belonging to two new genera of the family Margarodidae are described. The two new genera are *Pityococcus* and *Desmococcus*. Descriptions of the new species are presented along with pen and ink drawings and a key.
KEYW Margarodidae, *Matsucoccus, Pityococcus, Desmococcus,* pine-infesting.

404 AUTH McMinn, R. G.
DATE 1955
TITL Studies on the root systems of healthy and pole blight affected white pine (*Pinus monticola* Dougl.).
PUBL Unpublished Report. Victoria, BC: Canadian Department of Agriculture, Forest Biology, Division of Forest Biology Laboratory. 31 p.
ABST The root systems of a healthy and an unhealthy white pine were excavated for comparison. The unhealthy tree, which exhibited typical pole blight crown symptoms, was found to have considerable mortality in the smaller structural roots and a greatly reduced absorptive system. Root mortality in the adjacent healthy tree was slight. The degree of root deterioration in the pole-blight-affected tree appeared sufficient to account for the crown symptoms recorded.
KEYW Pole blight, pole blight root systems, needle number, pole blight crown class, mycorrhiza, rootlet types, *Phytophthora cinnanomi.*

405 AUTH McMinn, R. G.
DATE 1959
TITL A study of the relationship between pole blight and rooting characteristics of *Pinus monticola* Dougl.
PUBL In: 9th International Botanical Congress Proceedings. 2: 244.
ABST The root systems of thirty-five pole-sized *Pinus monticola* were excavated hydraulically. Analysis revealed that trees showing advanced decline symptoms in their crowns had serious root deterioration, particularly in their absorbing elements. Certain rooting characteristics seem to predispose this species to decline.
KEYW Pole blight, rooting characteristics, root deterioration.

406 AUTH McMinn, R. G.
DATE 1963
TITL Die mycorrhiza von *Pinus monticola* und die "pole-blight"-krankheit.
PUBL In: Mykorrhiza Proceedings, International Mykorrhiza Symposium. [Weimar, 1960], Gustav Fischer Jena. p. 257-260.
ABST The root systems of healthy and pole-blight-affected *Pinus monticola* were excavated hydraulically to determine whether root condition was correlated with degree of crown symptoms. The different forms of mycorrhizal short rootlets encountered were described. Most mycorrhizal rootlets in affected trees were poorly developed and the abundance of living rootlets was less than on healthy trees.
KEYW Root systems, mycorrhiza, pole blight.

407 AUTH McMinn, R. G.
DATE 1965
TITL Further observations on pole blight of white pine.
PUBL Canadian Department of Agricultural Science Service Bi-monthly Progress Report. 21(6): 3.
ABST Pole blight of western white pine is thought to have been initiated by a series of dry, hot summers which may have begun as early as 1917 and continued until the mid-1940's. Most of the affected trees examined in British Columbia were on noticeably podzolized soils, characteristic of the interior western hemlock zone. Pine stands in areas with relatively dry climates near the margin of the hemlock zone were rarely affected. The relatively favorable soil fertility of the weakly podzolized soils of these areas may have been more effective in promoting resistance to pole blight than drought was in causing the disease. Pole blight was also rare among pine growing toward the upper altitudinal limit of the species in the transition between the hemlock zone and the Engelmann spruce-subalpine fir zone. A significant characteristic of the sites on which pole blight occurred seems to be their ability, when appropriately stocked, to support rapid growth of pine during the early pole stage in normal and moist years.
KEYW Pole blight, British Columbia.

408 AUTH McMinn, R. G., Molnar, A. C.
DATE 1959
TITL Further observations on pole blight and climate.
PUBL Canadian Department of Agriculture Science Service Bi-monthly Progress Report. 15(1): 2-3.
ABST Observations on permanent sample plots have indicated that in the past few years there has been some improvement in the pole blight condition of western white pine. The coincidence of pole blight with the hot, dry part of a climatic cycle supports the hypothesis that this disease is related to the

occurrence of such conditions. This view is further corroborated by the fact that a reduced rate of symptom intensification and recovery trend in some trees was preceded and accompanied by cooler, moister summers.

KEYW Pole blight, climate.

409 AUTH McMullen, L. H., Atkins, M. D.
DATE 1959
TITL Life history and habits of *Scolytus tsugae* (Swaine) (Coleoptera: Scolytidae) in the interior of British Columbia.
PUBL Canadian Entomologist. 91: 416-426.
ABST The results of a study of the life history and habits of *Scolytus tsugae* (Swaine), made near Lumby and Lac la Hache, BC, indicate that the beetle in the interior of the province has a 1-year life cycle with one brood per year. The beetle overwinters in the larval stage, chiefly in the fourth instar. Although there has been some doubt that this species normally attacks *Pinus monticola*, cage studies indicate that it is probably a preferred host.
KEYW *Scolytus tsugae*.

410 AUTH Metcalf, M. E.
DATE 1952
TITL Lumber production approaches all-time record for Northern Rocky Mountain Region.
PUBL Research Note 103. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Western white pine lumber production in 1950 in the Northern Region of the U.S. Forest Service was 343,335,000 bd ft (20 percent of total).
KEYW Production lumber.

411 AUTH Millar, F. G.
DATE 1923
TITL The forestry situation in north Idaho.
PUBL Idaho Forester. 5: 19-22.
ABST Apprises the current timber situation in northern Idaho and outlines essentials of a "State forest policy" suggested for enactment by the legislature
KEYW Timber cut, lumbering, merchantable timber, restocking, forest policy.

412 AUTH Miller, D. L.
DATE 1978
TITL Lights and container size influence greenhouse growth of conifers.
PUBL Forest Technical Paper TP-78-4. Lewiston, ID: Potlatch Corporation. 10 p.
ABST White pine, Douglas-fir, and ponderosa pine were grown in size 2, 4, 7, and 8 containers under photoperiod lights, growth lights, and without supplemental lighting. At the end of the growth cycle, the seedlings were measured for height, caliper, shoot/root ratio, branching, and secondary needles. Photoperiod lights and the 4-cubic-inch container produced optimum growth of Douglas-fir and white pine. Ponderosa pine grew satisfactorily in the 8-cubic-inch container without supplemental lighting.
KEYW Artificial lights, containers for seedlings.

413 AUTH Miller, D. L.
DATE 1981
TITL Can we fall plant white pine?
PUBL Forest Research Note RN-81-6. Lewiston, ID: Potlatch Corporation. 7 p.
ABST Between 1977 and 1980 containerized white pine seedlings were planted on 12 sites during fall and spring planting seasons. First-, second-, and third-year data indicate that there is little difference in survival between fall- and spring-planted seedlings. Height growth was significantly less for fall plantings.
KEYW Fall planting, planting survival.

414 AUTH Miller, D. L.
DATE 1981
TITL The effects of Roundup herbicide on northern Idaho conifers and shrub species.
PUBL Forest Technical Paper TP-81-2. Lewiston, ID: Potlatch Corporation. 13 p.
ABST One, 2, and 3 quarts of Roundup herbicide in 10 gal aqueous solution per acre were aerially applied to six north Idaho test plots in early August 1978. The 1- and 2-qt rates were applied to additional plots in September 1979. The 1-qt rate was effective on thimbleberry and snowberry. The 2-qt rate controlled mountain maple and serviceberry. Three quarts per acre was required to control ninebark and produced 36 percent control on huckleberry. White pine and grand fir were not damaged. The 2- and 3-qt rates produced tip dieback on one-third of the Douglas-fir sprayed in early August. The September application produced no conifer injury.
KEYW Herbicides, Roundup.

415 AUTH Miller, D. L.
DATE 1981
TITL Should soil be firmed around seedling roots?
PUBL Forest Research Note RN-81-2. Lewiston, ID: Potlatch Corporation. 5 p.
ABST Containerized Douglas-fir and white pine were planted on five sites during late fall 1979 and early and late spring 1980. Half of

the seedlings planted had soil packed around the root plug. The rest were planted in dibble holes without packing. First-year results indicated that packing is not critical for late fall planting. Packing did produce a 0.7-inch (30 percent) height growth increase for early and late spring white pine plantings, and a 0.8-inch (35 percent) increase for late spring Douglas-fir plantings. Although survival was not significantly affected by root packing in this study (perhaps because of adequate soil moisture), packing is still recommended until data from drier years are available.

KEYW Planting procedure.

416 AUTH Miller, D. L., Breuer, D. W.
DATE 1984
TITL Effects of site preparation by burning and dozer scarification on seedling performance.
PUBL Forest Technical Paper TP-84-1. Lewiston, ID: Potlatch Corporation. 7 p.
ABST Containerized Douglas-fir and western white pine seedlings were planted on broadcast-burned, dozer-scarified, burned piles and untreated clearcut sites in northern Idaho. After three growing seasons, white pine seedlings were significantly taller on the untreated site. First-season Douglas-fir growth was better on the burned sites. After the third season, Douglas-fir seedlings on the scarified site were significantly shorter than on the other treatments. Survival of both species through the third year was not significantly affected by site preparation treatment. Competing vegetation cover was light on the untreated controls and may be responsible for the lack of significant advantage of site-prepared plots.
KEYW Site preparation, planting success.

417 AUTH Miller, D. L., Pope, W. W.
DATE 1982
TITL The effects of Garlon 3A and Garlon 4 on north Idaho conifers and shrubs.
PUBL Forest Technical Paper TP-82-3. Lewiston, ID: Potlatch Corporation. 11 p.
ABST The suspension of 2,4,5-T for forestry uses has produced the need for efficacy data for new and relatively untried herbicides. Toward this end, Garlon 3A and Garlon 4 herbicides were aerially applied to test plots in northern Idaho in September 1979. Garlon 4 at 3 lb ai/acre produced 94 percent control of snowbrush ceanothus three years following treatment. This rate produced 59 percent second-season mountain maple control. Third-season maple control was only 22 percent, however. Garlon 4, at 5 lb ai/acre, controlled huckleberry and sticky currant, but not thimbleberry; perhaps because of the late summer spray date. Garlon 3A was not effective for brush control. It produced 24 percent control on cherry, but produced little or no control on all other species. Garlon 4 application resulted in no conifer leader kill, but did moderately defoliate white pine (24 percent) and grand fir (27 percent) at the 5 lb ai/acre rate. Third-season height growth was normal. Garlon 3A produced no conifer damage at 3 lb ai/acre.
KEYW Herbicides, Garlon.

418 AUTH Miller, D. L., Schaefer, R. M.
DATE 1984
TITL The effects of container size on white pine and Douglas-fir survival and growth in north Idaho.
PUBL In: Proceedings, Joint Manufacturing, Western Forest Nursury Council/ Intermountain Nurseryman's Association. p. 1-5.
ABST This study was designed to determine the effect container size has on field survival and growth of western white pine. Between 1978 and 1982 field tests were installed in 13 plantations, and height growth and survival of styro-2, 4, and 8 seedlings were tracked for 2 to 5 years. Results indicate that styro-2 white pine survived as well as larger seedlings although height growth was slightly less. Greenhouse disease problems currently prevent growing operational quantities of styro-2 white pine, however. Styro-2 Douglas-fir performed as well as styro-4 seedlings on most sites. Styro-2 seedlings may be used on all but the driest Douglas-fir sites. In general, styro-8 seedlings were larger when planted and produced better height growth than styro-2 or 4 white pine and Douglas-fir seedlings. Increased survival and growth did not compensate for increased styro-8 production costs, however.
KEYW Containers, seedlings.

419 AUTH Miller, P. R.
DATE 1973
TITL Susceptibility to ozone of selected western conifers.
PUBL Abstracts of Papers, 2d International Congress of Plant Pathologists, Minneapolis, MN.
ABST The relative susceptibility to ozone of 12 western conifer species and two pine hybrids was investigated at Lake Arrowhead, in southern California. The injury scores representing order of decreasing susceptibility were: 15 down to 10—*Pinus monticola, P. jeffreyi* x *coulteri, Abies monticola, P. radiata* x *attenuata,* and *P. ponderosa*; 9.99

down to 5—*P. coulteri, Pseudotsuga menziesii, P. jeffreyi, P. ponderosa* (Rocky Mountain), *Abies concolor, Pseudotsuga macrocarpa,* and *P. attenuata*; 4.99 down to 1.5—*Libocedrus decurrens, P. lambertiana,* and *Sequoia gigantea.*

KEYW Ozone susceptibility.

420 AUTH Minore, D.
DATE 1979
TITL Comparative autecological characteristics of northwestern tree species—a literature review.
PUBL General Technical Report PNW-87. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 72 p.
ABST This report is a compilation of autecological information previously scattered about in several hundred publications. It includes a comparison of the tolerance, traits, and attributes of native northwestern tree species. The species are ranked with respect to 69 environmental factors, phenotypic characteristics, and physical parameters.
KEYW Autecology, native plants.

421 AUTH Minore, D., Dubrasich, M. E.
DATE 1981
TITL Regeneration after clearcutting in subalpine stands near Windigo Pass, Oregon.
PUBL Journal of Forestry. 79: 619-621.
ABST Subalpine units of mountain hemlock near Windigo Pass, OR, did not regenerate immediately after being clearcut between 1959 and 1962. They were adequately stocked 9 to 12 years later, however, regardless of postharvest treatment. Natural regeneration was adequate. Major regenerating species were mountain hemlock, western white pine, lodgepole pine, Shasta red fir, Ponderosa pine, Pacific silver fir, and Douglas-fir.
KEYW Regeneration.

422 AUTH Mirov, N. T.
DATE 1946
TITL Viability of pine seed after prolonged cold storage.
PUBL Journal of Forestry. 44(3): 193-195.
ABST Reports on germination of seed of 21 species of pine kept in cold storage for periods ranging from 5 to 15 years. The results show that seeds of some pines will keep for a long time without losing their viability.
KEYW Pine seed, cold storage, viability, seed germination, stratification.

423 AUTH Mirov, N. T., Iloff, P. M., Jr.
DATE 1954
TITL Composition of gum turpentines of pines. XX. A report on *Pinus chihuahuana* from Durango, *P. apacheca* from Arizona, and *P. monticola* from northern Idaho.
PUBL Journal of American Pharmacology Association. 63: 378-381.
ABST Oleoresin from western white pine used in this investigation was obtained from Priest River Experimental Forest, ID, the area of optimal development of this species. The turpentine was obtained by heating oleoresin under reduced pressure so that at the end of distillation, the temperature reached 180 degrees and the pressure was 0.1 mm of mercury. Yield of turpentine was 20 percent. *Pinus monticola* from northern Idaho contained 2-3 percent n-heptane, 32 percent 1-and-dl-alpha-pinene, 45 percent 1-beta-pinene, 7 percent 1-limonene, 2 percent undecane, 2 percent bornyl acetate, 4-5 percent sesquiterpenes of which one is monocyclic and another bicyclic, and 7 percent pot residue and loss.
KEYW Oleoresin.

424 AUTH Moessner, K. E.
DATE 1963
TITL A test of aerial photo classifications in forest management-volume inventories.
PUBL Research Paper INT-3. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 16 p.
ABST A number of photo and map stratification schemes were studied using data from the St. Regis (Montana) test area in the western white pine type. Photo-volume classes offer the best means of stratification.
KEYW Aerial photo classification, volume inventory.

425 AUTH Moeur, M.
DATE 1981
TITL Crown width and foliage weight of Northern Rocky Mountain conifers.
PUBL Research Paper INT-283. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 14 p.
ABST Equations were derived for predicting crown width of trees from diameter, height, crown length, and basal area per acre, and for predicting foliage weight of trees from diameter, height, crown length, age, relative diameter, and number of trees per acre. Coefficients were estimated for 11 conifer species in northern Idaho and western Montana. Embedding these equations in the Prognosis Model for Stand Development will enhance the prediction of vegetation

characteristics needed for interfacing insect outbreaks, wildlife habitat, and watershed models.
KEYW Crown width prediction, Prognosis Model, stand development.

426 AUTH Molina, R., Trappe, J. M.
DATE 1982
TITL Patterns of ectomycorrhizal host specificity and potential among Pacific Northwest conifers and fungi.
PUBL Forest Science. 28(3): 423-458.
ABST Twenty-seven fungus species with diverse sporocarp-host associations were tested for ectomycorrhiza formation with seven Pacific Northwest conifers: *Pseudotsuga menziesii, Tsuga heterophylla, Larix occidentalis, Picea stichensis, Pinus contorta, P. ponderosa,* and *P. monticola*. The fungi varied widely in their ability to form mycorrhizae with the various conifers. The fungi with wide sporocarp-host associations showed no incompatibility with any of the hosts, and it is suggested that they may share a compatibility or recognition factor common to many ectomycorrhizal hosts. The specialized fungi with specific sporocarp-host associations often showed incompatibility with other nonassociated hosts. Disruption of the cortex by the invading fungus and lignification as indicated by intense safranin staining of cortical cells were the most common indicators of incompatibility. This host reaction suggests a type of phenolic defense mechanism as displayed in many plant-pathogen interactions.
KEYW Symbionts, mycorrhiza.

427 AUTH Molnar, A. C.
DATE 1955
TITL Development of pole blight in permanent sample plots.
PUBL Unpublished report. Victoria, BC: Canadian Department of Agriculture, Forest Biology Division, Forest Biology Laboratory. 20 p.
ABST Data collected from permanent sample plots are tabulated and discussed. Pole blight has continued to increase in all plots. Crown position had an influence on the rate trees became diseased, and intensification of symptoms and decline of trees was more severe with rise in crown position. Sanitation thinnings did not decrease pole blight.
KEYW Pole blight, *Dendroctonus, Dioryctria, Vespamima, Armillaria mellea*, pole blight crown class, pole blight thinning plots.

428 AUTH Molnar, A. C.
DATE 1956
TITL *Pullularia pullulans* associated with a flagging disease of western white pine.
PUBL Unpublished report. Victoria, BC: Canadian Department of Agriculture, Forest Biology Division, Forest Biology Laboratory. 20 p.
ABST A disease causing flagging of twigs and branchlets of immature western white pine is reported. The causal agent appears to be *Pullularia pullulans*.
KEYW *Pullularia pullulans, Pineus*.

429 AUTH Molnar, A. C., McMinn, R. G.
DATE 1958
TITL The current status of pole blight in British Columbia.
PUBL Canadian Department of Agriculture, Science Service, Bi-monthly Progress Report. 14(3): 3-4.
ABST In British Columbia, the pole blight disease of western white pine has been under continuous observation and investigation since it was first discovered in 1949. Early surveys and plot records indicated an alarmingly rapid intensification of the disease, and heavy losses from mortality were anticipated. While these early fears were justified by the rapid progress of the disease on permanent sample plots up to 1953, more recently there has been a marked decrease in disease intensification. An improvement in stand condition has, in fact, been recorded on both disease progress and thinning plots, and a similar trend has been observed in other pine stands. This trend appears to have been sufficiently sustained to warrant a reappraisal of the potentialities of pole blight.
KEYW Pole blight, British Columbia.

430 AUTH Molnar, A. C., McMinn, R. G.
DATE 1960
TITL The origin of basal scars in British Columbia interior white pine type.
PUBL Forestry Chronicle. 36: 50-60.
ABST Basal scarring, a conspicuous abnormality of western white pine and its associated species in the interior region of British Columbia, was found to be chiefly attributable to injury by bears, infections of *Armillaria mellea*, fire, mechanical wounding, and the pole blight disease. Diagnostic characteristics, which facilitated classification of scars, even those of advanced age, were found and described. The implications of the various types of scarring are considered.
KEYW Basal scars, bear damage, *Armillaria mellea*, fire damage, pole blight.

431 AUTH Morrell, F.
DATE 1924
TITL Forest economics in north Idaho.
PUBL Idaho Forester. 6: 6-8, 49.

ABST There are about 10 million acres of forest lands north of the Salmon River. Forty-six percent of this area bears merchantable timber. Thirty-three percent bears a stand of poles, young growth, and reproduction. The author further discusses the productive capabilities, value of the timber, and impact on the population of Idaho.
KEYW Forest economics.

432 AUTH Morrison, H.
DATE 1941
TITL Injury by sugar pine *Matsucoccus* scale resembles that of blister rust.
PUBL Journal of Forestry. 39: 488-489.
ABST *Matsucoccus paucicicatrices* damage to *Pinus lambertiana* resembles that of white pine blister rust (*C. ribicola*). Early stages of injury are sometimes so similar to blister rust cankers that microscopic examination is necessary for a positive diagnosis. In light of this, added difficulties can be expected in determining yearly blister rust advances throughout the range of commercial sugar pine.
KEYW *Matsucoccus paucicicatrices, Pinus lambertiana*, white pine blister rust, flags, cankers.

433 AUTH Moss, V. D.
DATE 1943
TITL Preliminary report on the use of germinated seed as a method of reforestation for western white pine.
PUBL Berkeley, CA: U.S. Department of Agriculture, Division of Plant Disease Control Series 115. 31 p. [Mimeo.]
ABST Direct seeding is reviewed in the light of four principal factors: (1) control of seed-eating rodents (mechanical protectors and poison baits), (2) germination of a sufficient number of seeds to provide a fully stocked stand of timber (fall sowing, spring sowing), (3) adequate control of seedling mortality (cutting insects, drought, insolation, fungi), and (4) reduction of cost below that of standard planting for establishment of comparable forest cover. Data are shown from field plots on light, soil moisture, and soil temperature in relation to germination, establishment, and survival of western white pine to justify a tentative conclusion that artificially germinated pine seed may be safely sown in the early spring sooner than it would germinate under natural conditions.
KEYW Direct seeding, rodents, seed germination, fall sowing, spring sowing, cutting insects, drought, insolation, fungi.

434 AUTH Mott, R. L., Amerson, H. V.
DATE 1981
TITL Tissue culture plantlets produced from *Pinus monticola* embryonic materials.
PUBL Forest Science. 27: 299-304.
ABST Methodology for tissue culture propagation of clones from western white pine, *Pinus monticola*, embryonic materials is presented, and the efficiency of clone production is discussed. Bud initiations from excised cotyledons yielded 17.6 buds per clone, whereas initiations from whole embryos yielded 7.4 buds per clone. Regardless of the initiation method, about 19 percent of the buds initiated eventually elongated to a height of 5 mm or more. Currently, 30 percent of these can be rooted.
KEYW Adventitious buds, conifer culture, clone production efficiency, propagule rooting.

435 AUTH Murison, W. F.
DATE 1959
TITL Ecological and physiological requirements of western white pine, grand fir and Engelmann spruce.
PUBL In: Ecology of the forests of the Pacific Northwest. Progress Report, 23 p. Appendix B, p. 6-11. Unpublished report on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID.
ABST Qualitative data are presented for each of five species showing the severity and area of concentration of deficiency symptoms related to low levels of N, S, Mg, Ca, P, and K. Quantitative data have been collected also, some of which are presented here.
KEYW Ecological requirements, *Abies grandis, Picea engelmannii.*

436 AUTH Mutuura, A., Munroe, E., Ross, D. A.
DATE 1969
TITL American species of *Dioryctria* (Lepidoptera: Pyralidae).
PUBL Canadian Entomologist. 101: 1009-1023.
ABST *Dioryctria tumicolella* from pine blister rust, peridermium swellings on *P. contorta* in British Columbia, Alberta, and Washington, and *D. banksiella* from trunks of *P. banksiana* in Alberta, Northwest Territories, and eastward are described as new species and distinguished from the western *D. cambiicola* and the eastern *D. zimmermani.*
KEYW *Dioryctria monticolella, Dioryctria,* Lepidoptera.

437 AUTH Nemeth, L. J.
DATE 1967
TITL Determination of allowable working stresses for vertically laminated beams.
PUBL Forest Products Journal. 17: 23-30.
ABST Gives results of stress tests on western white pine vertically laminated beams of three laminations.

KEYW Working stress, laminated beams.

438 AUTH Nettleton, H. I.
DATE 1962
TITL Growth of white pine on logged-off areas.
PUBL University of Idaho Bulletin. 3(5): 1-2.
ABST Release of suppressed western white pines following logging is discussed in terms of diameter and height growth changes. Response in both growth catagories is positive. Logging of these released trees is presented as both profitable and feasible.
KEYW Growth release.

439 AUTH New Zealand Forest Service
DATE 1967
TITL *Dothistroma pini* project.
PUBL New Zealand Forest Service, Forest Research Institute, Annual Report. 67: 47-55.
ABST The indications given in last year's report are largely confirmed, except that young *Pinus muricata* now appears to be very highly susceptible, falling in the same catagory as *P. attenuata.* A few individual trees of *P. ayacahuite, P. patula, P. strobus, P. pseudostrobus,* and *P. michoacana* are mildly susceptible, while 50-75 percent of the trees of *P. lambertiana, P. monticola, P. taeda, P. contorta,* and *P. elliottii* show traces of the disease. Only *P. montezumae* shows no evidence of infection. Clones grafted from mature *P. radiata* trees onto young rootstock are as susceptible as normal seedlings.
KEYW *Dothistroma pini*, susceptibility, resistance, white pine species.

440 AUTH Nickle, W. R.
DATE 1960
TITL Nematodes associated with the rootlets of western white pine in northern Idaho.
PUBL Plant Disease Reporter. 44: 470-471.
ABST Several genera of plant-parasitic nematodes have been found in soil and root samples taken throughout the white pine type in northern Idaho. This investigation was carried out to provide information pertaining to a disease of western white pine known as pole blight. Female nematodes of the genus *Heterodera* have been found embedded in white pine rootlets taken from a diseased stand. These forms appeared destructive to the mycorrhizal rootlets. Observations and preliminary tests indicate that western white pine is a host of *Trichodorus elegans* Allen. This stubby-root nema has been found in all pole-blighted areas sampled and was not generally found in stands that did not exhibit pole blight symptoms. Other plant parasitic nematodes, belonging to the genera *Criconemoides, Criconema, Helicotylenchus,* and *Tylenchorhynchus*, have been recovered from soil samples taken from the rhizosphere of diseased white pine trees.
KEYW Pole blight, *Heterodera, Trichodorus, Criconemoides, Criconema, Helicotylenchus, Tylenchorhynchus,* nematodes.

441 AUTH Nickles, W. C., Rowe, J. W.
DATE 1962
TITL Chemistry of western white pine bark.
PUBL Forest Products Journal. 62: 374-376.
ABST Analyses of western white pine bark show that it contains up to 25 percent of extractives that can be removed by successive extraction with benzene, alcohol, and water, 30 percent of carbohydrate that was not extracted by neutral solvents, 39 percent of "lignin," and 1.2 percent of ash. The amounts of different sugars and other constituents in the whole bark as well as in the residues from extracting the whole bark with neutral solvents and hot 1-percent aqueous sodium hydroxide solution were determined in this study.
KEYW Bark chemicals.

442 AUTH Nord, F. F., Hata, K.
DATE 1969
TITL Fungal degradation of pine bark lignin.
PUBL In: Current aspects of biochemical energetics. New York: Academic Press. p. 315-329.
ABST The outer bark of western white pine was exposed to the enzymatic activity of white-rot fungi and the change in the amount of bark components, especially lignin, was studied in comparison with those components of wood. The degradation of the bark was very difficult even after preparing an extractive-free sample. *Collybia butyracea* decomposed lignin in bark as well as in wood. Bark phenolic acids could hardly be degraded by the fungi, whereas bark MW lignin was degraded as easily as wood MW lignin. The degradation compounds from the decayed bark and wood medium were studied by thin-layer chromatography. Vanillic acid was identified from the wood medium, and protocatechuic acid, extensively, from the bark medium, indicating that at the earlier stage of degradation of bark the fungus destroys mainly bark phenolic acids that are covering lignin and other components of bark.
KEYW Bark lignin, fungal degradation, white rot fungi, *Collybia butyracea*, bark phenolic acids.

443 AUTH Ollieu, M. M., Schenk, J. A.
DATE 1966

TITL The biology of *Eucosma rescissoriana* Heinrich in western white pine in Idaho (Lepidoptera: Olethreutidae).
PUBL Canadian Entomologist. 98: 268-274.
ABST *Eucosma rescissoriana* Heinrich is highly destructive to cones and seed of western white pine and is distributed throughout the geographic range of this host species in northern Idaho. One generation is passed per year with emergence in late May. Egg and larval stages are generally found in June and July; the pupal stage overwinters. Stand density and elevation were used as variables in ecological studies of population size. All stages of *E. rescissoriana* were correlated to phenological data in 1962.
KEYW Cone insects, seed insects, *Eucosma rescissoriana*.

444 AUTH Olson, D. S.
DATE 1923
TITL Forest planting in Montana and northern Idaho.
PUBL Applied Forestry Note 40. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST In the white pine type, 27,000 acres had been planted by 1923, with 90 percent having an established stand of 100 or more trees per acre. A conservative estimate of acreage needing reforestation was 75,000 acres (acres that had been burned over two or more times). Direct seeding was abandoned because of rodents and summer droughts.
KEYW Planting, reforestation, direct seeding.

445 AUTH Olson, D. S.
DATE 1930
TITL Growing trees for forest planting in Montana and Idaho.
PUBL Circular 120. Washington, DC: U.S. Department of Agriculture. 91 p.
ABST Discusses the selection and a development of a nursery site and thoroughly describes all nursery practices at the Savenac Nursery.
KEYW Nursery, seed storage, planting stock, seed germination, Savenac Nursery, nursery practices.

446 AUTH Olson, D. S.
DATE 1932
TITL Germinative capacity of seed produced from young trees.
PUBL Journal of Forestry. 30: 871.
ABST Casual observations show that *P. monticola* may bear cones as early as 10 years of age. Seed tests of 600 seeds each from seven lots showed that 10- to 17-year-old trees averaged 39 percent germination, 21- to 26-year-old trees averaged 55 percent germination. This compares with 54.5 percent for a large quantity of seed from trees 60 years old and over.
KEYW Seed germination, young trees, cone production, *Pinus ponderosa, Pinus contorta, Larix occidentalis, Thuja plicata.*

447 AUTH Olson, D. S.
DATE 1932
TITL Seed release from western white pine and ponderosa pine cones.
PUBL Journal of Forestry. 30: 748-749.
ABST A very meager experiment based on two cones of western white pine and ponderosa pine found that most of the seed was released in the spring. This was an unexpected result.
KEYW Seed release.

448 AUTH Olson, D. S.
DATE 1952
TITL Underground damage from logging in the western white pine type.
PUBL Journal of Forestry. 50: 460-462.
ABST "Logging shock" results in considerable loss of trees and arrested growth in residual stands of western white pine type. In the past, emphasis has been placed almost entirely upon logging damage above ground. Modern methods of logging are causing much damage underground—to roots of the residual trees. This type of damage may be very severe and may require changes in cutting practices for the western white pine type. The problem seems to be serious enough to warrant intensive investigation.
KEYW Logging damage, underground damage, pole blight, root damage, growth.

449 AUTH Olson, D. S.
DATE 1953
TITL Preliminary tests on relative inflammability of logging slash by species in western white pine type.
PUBL Research Note 5. Moscow, ID: University of Idaho, Forest, Wildlife, and Range Experiment Station. 6 p.
ABST Past concepts of slash inflammability by species are upset, especially by the unexpected fire behavior in western larch, western hemlock, and western redcedar slash. There undoubtedly is a short period when larch needles provide a "flashy" fuel for rapid flame spread. At other times, this species may be the least dangerous. Western hemlock may be more dangerous than commonly rated because of the high ratio of needles and fine twigs to branchwood. The same is true of Douglas-fir and Engelmann spruce. Inflammability in

spruce slash is reduced by early needle cast. Fires in the pine plots generated a great deal of heat.

KEYW Logging slash inflammability.

450 AUTH Olson, D. S.
DATE 1953
TITL Solids and voids in logging slash.
PUBL Research Note 8. Moscow, ID: University of Idaho, Forest, Wildlife, and Range Experiment Station. 4 p.
ABST Logging slash in its natural form is a loose, bulky mass. The high ratio of foliage to branchwood volume presents two important considerations: (1) The large volume of "kindling fuels" makes the slash highly inflammable. (2) The most inflammable portion of the slash may be expected to separate from the coarser material and decompose in a relatively short time.
KEYW Logging slash, branchwood solids, needle solids, *Tsuga heterophylla, Thuja plicata, Picea engelmannii, Pseudotsuga menziesii.*

451 AUTH Olson, D. S., Fahnestock, G. R.
DATE 1955
TITL Logging slash: a cooperative study of the problem in Inland Empire forests.
PUBL Idaho Forester. 1: 52.
ABST Describes the biological and legal problems with logging slash from a practical and a research point of view.
KEYW Logging slash, slash disposal, slash inflammability.

452 AUTH On, D.
DATE 1952
TITL 2,3,5-triphenyl tetrazolium chloride as a viability indicator of certain coniferous seeds.
PUBL Journal of Forestry. 50: 868.
ABST 2,3,5-triphenyl tetrazolium chloride was tested for use as a seed viability indicator for western white pine, pinyon pine, ponderosa pine, and Douglas-fir. Results correlated closely with results of direct germination tests.
KEYW Seed viability, tetrazolium, viability indicator.

453 AUTH Otter, F. L.
DATE 1933
TITL Idaho's record trees.
PUBL Idaho Forester. 15: 37-39.
ABST The following record western white pines are listed: cut - Marble Creek, 92-inch stump, 480 years; standing - Little North Fork of the Clearwater River, 84 inches d.b.h.; cut - Kaniksu National Forest (cut 1922, 15 merchantable logs; no other measurements available).
KEYW Record trees.

454 AUTH Owens, J. N., Molder, M.
DATE 1977
TITL Development of long-shoot terminal buds of western white pine (*Pinus monticola*).
PUBL Canadian Journal of Botany. 55: 1308-1321.
ABST Long-shoot terminal bud (LSTB) development in western white pine was studied throughout the annual growth cycle to determine the phenology of LSTB development and the time of cone-bud differentiation. Development of LSTB began in early April and cataphylls were initiated from mid-August until early November. Cataphyll initiation was slow during May and June when shoots were elongating and then rapid just after shoot elongation was completed. Proximal cataphylls were sterile, whereas more distal cataphylls began to initiate axillary buds by late June or early July. Axillary buds were initiated first in the proximal portions of the LSTB and then acropetally in rapid succession. The last cataphylls to be initiated in the fall remained as sterile bud scales enclosing the LSTB apex. Axillary buds initiated sterile cataphylls which functioned as bud scales. Attempts to induce or enhance seed-cone production in *P. monticola* would probably be most successful in the spring when seed-cone buds differentiate. LSTB-bearing seed cones were larger, had broader apices, and produced more cataphylls during the growing season than did LSTB-bearing pollen cones.
KEYW Long-shoot terminal buds, phenology terminal buds, axillary buds, seed cones, pollen cones, cataphyll initiation, cone-bud differentiation.

455 AUTH Packer, P. E.
DATE 1962
TITL Elevation, aspect, and cover effects on maximum snowpack water content in a western white pine forest.
PUBL Forest Science. 8: 225-235.
ABST Maximum snowpack water content in a small white pine-forested watershed in northern Idaho during four winters was related to elevation, aspect, and density of forest canopy. The largest increases in snow water content occurred with diameter and basal area reductions in the densest forest stands and became smaller with comparable diameter and basal area reductions in more open stands.
KEYW Water content, snowpack.

456 AUTH Packer, P. E.
DATE 1971
TITL Terrain and cover effects on snowmelt in a western white pine forest.

PUBL Forest Science. 17(1): 125-134.
ABST Whether increases in snowpack water that result from cutting timber in western white pine forests of the Northern Rocky Mountains can create flood-producing conditions depends, in part, upon the melting behavior of the snowpack under various terrain and forest conditions. Reported are results of a 4-year study which show that snowmelt (ablation) rates are influenced significantly by differences in terrain and forest cover conditions.
KEYW Snowmelt, stand density, air temperature, radiant energy.

457 AUTH Parker, A. K.
DATE 1951
TITL Pole blight recorded on the British Columbia coast.
PUBL Forest Pathology Note 4. Victoria, BC: Dominion Laboratory of Forest Pathology. (Mimeo.)
ABST Describes the presence of pole blight on the coast. A fungus, tentatively identified as a species of *Scopularia*, was isolated from one of the affected trees.
KEYW Pole blight, *Scopularia.*

458 AUTH Parker, A. K.
DATE 1953
TITL Pole blight of western white pine.
PUBL Canadian Department of Agriculture, Science Service Bi-monthly Progress Report. 9(1): 4.
ABST Of the nine fungi most frequently isolated in 1949 and 1950 from white pines affected by the pole blight, only a species of *Leptographium* was found capable of producing lesions similar to those associated with the disorder. Inoculation experiments in the interior and coastal regions indicated an association of the *Leptographium* sp. with pole blight. In the light of data obtained through current studies and from previous analyses of affected trees, however, there is considerable doubt that this fungus is the sole cause of the disorder.
KEYW Pole blight, *Leptographium.*

459 AUTH Parker, A. K.
DATE 1957
TITL The nature of the association of *Europhium trinacriforme* with pole blight lesions.
PUBL Canadian Journal of Botany. 35: 845-856.
ABST *Europhium trinacriforme* was the only organism isolated more than twice from pole blight lesions and found to be pathogenic to white pine. However, examinations of the number and size of lesions on pole-blighted trees and the results of inoculations, isolations, and histological studies indicated that *E. trinacriforme* most likely gains entrance to lesions that are already formed from other causes and extends them.
KEYW *Europhium trinacriforme*, pole blight lesions, inoculation, radial increment.

460 AUTH Parker, A. K.
DATE 1958
TITL Studies on *Europhium trinacriformis* spec. nov. the perfect stage of a species of *Leptographium* isolated from lesions on western white pine affected with pole blight.
PUBL Forestry Chronicle. 34: 328.
ABST The perfect stage of a species of *Leptographium* isolated from lesions on western white pine affected with pole blight has been described as *Europhium trinacriformis* and a method has been outlined for obtaining *perithecia* in culture. Studies on the sexuality of the fungus have revealed it to be heterothallic with two compatability types. Cross-fertilization experiments revealed the presence of isolates which acted as either males, females, or hermaphrodites. *E. trinacriformis* was isolated from 11 percent of the lesions on western white pine affected with pole blight in the interior region of British Columbia and from 84 percent of the lesions on affected trees in the coast region. The fungus was the only pathogenic organism isolated more than twice from lesions, and it was shown to be capable of producing lesions similar in several respects to pole blight lesions. However, further data from isolation, inoculation, histological, and radial growth studies have shown that pole blight lesions were not caused directly by *E. trinacriformis*. It is most likely that the fungus gained entrance to lesions already formed and occasionally extended them.
KEYW *Europhium trinacriformis, Leptographium*, pole blight.

461 AUTH Parker, A. K., Collis, D. G.
DATE 1966
TITL *Dothistroma* needle blight of pines in British Columbia.
PUBL Forestry Chronicle. 42: 160-161.
ABST *Dothistroma* needle blight is reported to be widespread throughout British Columbia on three native pines, and present on six species of exotic pines grown on Vancouver Island. A description of the disease is given.
KEYW *Dothistroma pini*, needle blight, British Columbia, *Actinothyrium marginatum.*

462 AUTH Parker, A. K., Mulnar, A. C.
DATE 1952
TITL Pole blight of western white pine.

PUBL Canadian Department of Agriculture, Science Service, Bi-monthly Progress Report. 7(6): 4.

ABST The final series of permanent sample plots arising from the pole blight survey have been established in the Nelson Forest District of British Columbia. This work, initiated in 1950, has the following main objectives: (1) to study the progress of pole blight symptoms within individual trees, (2) to determine the nature of spread of the disease, (3) to determine the feasibility of control through sanitation thinning. The first authentic record of pole blight in living white pine in the coastal region of western North America has been made near Duncan, BC, and analyses have indicated its presence there for at least 8 years. Additional scouting has subsequently confirmed its presence near Bowser and Qualicum Bay on Vancouver Island and near Hope on the adjacent mainland. Cultural studies are being undertaken on a species of *Scopularia*, a fungus commonly associated with the disease and known to be capable of producing lesions similar to those found on pole-blighted trees.

KEYW Pole blight, pole blight survey, *Scopularia*.

463 AUTH Parker, A. K., Waldie, R. A., Foster, R. E.
DATE 1950
TITL Pole blight, a previously unreported disease of western white pine in British Columbia.
PUBL Forest Pathology Note 3. Victoria, BC: Dominion Laboratory of Forest Pathology. (Mimeo.)
ABST The first reported appearance of pole blight in Canada is described and mapped.
KEYW Pole blight.

464 AUTH Parker, J.
DATE 1951
TITL Moisture retention in leaves of conifers of the Northern Rocky Mountains.
PUBL Botanical Gazette. 113: 210-216.
ABST Leaves of ponderosa pine retained more moisture when attached to cut branches than did those of Douglas-fir, western white pine, arborvitae, grand fir, or Engelmann spruce. Leaves of Douglas-fir and ponderosa pine retained a higher moisture content on the average when the leaves were removed from the branches and allowed to dry in the laboratory. Cut leaves of arborvitae and white pine showed no significant differences in moisture retained, but cut leaves of both species retained more moisture than did leaves of grand fir or spruce. The tetrazolium test did not indicate any results to substantiate the claim that the more drought-resistant coniferous species are better able to recover from a low content of leaf moisture than are those less drought-resistant. Leaf shrinkage was closely associated with water loss.
KEYW Moisture retention, leaves, tetrazolium test, drought.

465 AUTH Parker, J.
DATE 1952
TITL Environment and forest distribution of the Palouse Range in northern Idaho.
PUBL Ecology. 33: 451-461.
ABST In the Palouse Range of northern Idaho, the tree species show transitions from one habitat to another as one progresses along a compass line over varying topography.
KEYW Environment, forest distribution.

466 AUTH Paul, B. H.
DATE 1962
TITL Properties and uses of western pines.
PUBL Hitchcock's Wood Working Digest. 1962 January: 43-46.
ABST Western white pine is most abundant in northern Idaho. It occurs also in western Montana, Washington, and Oregon. Western white pine, known also as Idaho white pine, has physical and mechanical characteristics similar to eastern white pine. It is difficult to tell the two species apart except on the basis of origin. The lower grades of lumber are used for boxes, crates, and light construction. The better grades are shipped to eastern markets and utilized for the same purposes as eastern white pine. A considerable portion (20 percent in 1948) of the lumber cut is used for the manufacture of matches. It is also used for doors, frames, sashes, siding, and exterior and interior trim. Other uses are numerous; in fact it has been said that western white pine is suitable for use in nearly every part of a house, because of the ease with which it can be cut and shaped with tools, its ability to stay in place, its ability to take and hold paint and enamel, and its nailing properties.
KEYW Uses.

467 AUTH Pfister, R. D.
DATE 1969
TITL Effect of roads on growth of western white pine plantations in northern Idaho.
PUBL Research Paper INT-65. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST The potential loss of timber-producing land from roads is minor and can be reduced if road widths are kept to the minimum actually needed. Roads need to be less than 14 ft wide and trees must occupy the side up to the toe of the fill and near the top of the cut.

KEYW Roads versus timber production.

468 AUTH Pfister, R. D.
DATE 1974
TITL Habitat types and regeneration.
PUBL Permanent Association Committee Proceedings. Portland, OR: Western Forest and Conservation Association. p. 120-125.
ABST Discusses the habitat type method of ecological classification and its applications in regeneration planning, especially (1) choice of silvicultural systems, (2) choice of species, (3) site preparation techniques, (4) regeneration probabilities, (5) choice of regeneration methods, and (6) seed collection practices. Several examples are presented to illustrate this habitat type-regeneration planning relationship.
KEYW Habitat type, ecological classification, regeneration planning, silvicultural treatments, succession, site preparation, seed collection, environmental stratification, management guidelines.

469 AUTH Pfister, R. D., Kovalchik, B. L., Arno, S. F., Presby, R. C.
DATE 1977
TITL Forest habitat types of Montana.
PUBL General Technical Report INT-34. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 173 p.
ABST A total of nine climax series, 64 habitat types, and 37 phases of habitat types are defined. Potential productivity for timber, climatic characteristics, and surface soil characteristics are described for each type.
KEYW Habitat types, Montana habitat types.

470 AUTH Phelps, W. R., Leaphart, C. D.
DATE 1968
TITL A comparison of the translocation and persistence of cycloheximide (acti-dione) in eastern and western white pine.
PUBL Forest Science. 14: 275-276.
ABST After basal stem application, cycloheximide was absorbed and moved systemically throughout pole-size eastern and western white pine. It was translocated both upward and downward in the tree bole. The antibiotic was absorbed faster, and moved in greater quantities but at a slower rate, in eastern than in western white pine.
KEYW Cycloheximide, actidione, translocation.

471 AUTH Pillow, M. Y.
DATE 1953
TITL How growth of white pine affects its properties for matches.
PUBL FPL-1950. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 7 p.
ABST Research findings on growth and intrinsic wood characteristics can improve industrial inspection procedures by providing means of eliminating wood that is inherently weak due to the conditions under which it was grown. Variations in density and fiber structure can be discerned, and means of grading that exclude unsuitable forms are available and practical. Characteristics of value for grading purposes include annual ring width and variations in the form of compression wood.
KEYW Matches, density wood, fiber structure.

472 AUTH Pissot, H. J.
DATE 1953
TITL Forest resources of north Idaho.
PUBL Station Paper 35. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 26 p.
ABST Lists western white pine as the principal sawtimber tree, comprising 22 percent of board foot volume and 18 percent of cubic foot volume. White pine is also listed as being the principal species cut in the decade 1941-50, with 38 percent of the sawlog production being western white pine. Includes the following data for all principal species: estimated differences in area statistics by major land and stand-size class, area of commercial forest land by major forest types, net volume of live sawtimber and growing stock on commercial forest land by species, by diameter class groups, annual sawlog production, annual lumber production, annual pulpwood production, annual pole production, and forest type classes.
KEYW Species comparisons, forest types.

473 AUTH Pitman, G. B.
DATE 1971
TITL Trans-verbenol and alpha-pinene: their utility in manipulation of the mountain pine beetle.
PUBL Journal of Economic Entomology. 64(2): 426-430.
ABST As behavior-regulating chemicals, trans-verbenol and alpha-pinene were effective in manipulating the host selection patterns of *Dendroctonus ponderosae*. When 725 mature white pines, distributed over eight 40-acre plots in northern Idaho, were baited with the two materials, 133 or 18 percent were attacked heavily and subsequently killed. Prior to baiting, all trees were

sprayed to a height of about 20 ft with a 2.3 percent solution of lindane. The mortality of sprayed trees suggested that lindane was not effective under the conditions of this study. Only 21 of the estimated 7,200 unbaited mature pines within the boundaries of the study plots were mass attacked, and 11 of these trees were within 10 to 15 ft of baited mass-attacked trees. Paperboard cylinders covered with a tacky substance and baited with trans-verbenol and alpha-pinene appeared effective as a means of deadtrapping *D. ponderosae.*

KEYW *Dendroctonus ponderosae*, trans-verbenol, alpha-pinene, myrcene, limonene, manipulating, lindane, deadtrapping.

474 AUTH Plank, G. H., Gerhold, H. D.
DATE 1965
TITL Evaluating host resistance to the white-pine weevil, *Pissodes strobi*, (Coleoptera: Curculionidae) using feeding preference tests.
PUBL Annals of the Entomological Society of America. 58: 527-532.
ABST Results of experiments in which white-pine weevils, *Pissodes strobi,* were caged on cut leaders show that weevils are capable of distinguishing and expressing feeding preferences among three of their host species—eastern white pine, jack pine, and red pine—very similar to patterns observed in the field. There was no difference in amount of feeding on eastern white pine or western white pine, or between two classes based on past weeviling, despite a large difference in susceptibility. In none of the four species was amount of feeding correlated with any of the morphological features which were measured at 10 inches from the base of the terminal bud.
KEYW Host resistance, white pine weevil, *Pissodes strobi,* feeding preference.

475 AUTH Plank, M. E., Snellgrove, T. A.
DATE 1973
TITL Lumber yield from western white pine in northern Idaho.
PUBL Research Paper PNW-153. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 30 p.
ABST A sample of 300 trees was selected to represent the full range in size and quality of commercial sawtimber available in northern Idaho. A net log scale of 167,900 bd ft (Scribner) was sawed from 1,431 logs in a typical white pine mill, producing 212,703 bd ft of lumber. Lumber yields for each lumber grade are presented by log grade and diameter class. The study showed a recovery of 17 percent molding and selects; 5 percent No. 3 clear, No. 1 and 2 shop; and 78 percent common.
KEYW Log yield, lumber, forest industries.

476 AUTH Porter, A. W.
DATE 1964
TITL On the mechanics of fracture in wood.
PUBL Forest Products Journal. 14: 325-331.
ABST An elastic fracture theory based upon an energy balance has been successfully applied to the opening mode fracture of western white pine wood in the 1t and 1r planes. This approach led to the establishment of material parameter, termed the "strain-energy release rate" or GIC which was independent of changes in specimen geometry and crack length. Knowledge of GIC permits a prediction of combinations of stress and crack length which will result in rapid crack propagation and lead to final failure. GIC also provides a convenient basis for relating the fracture resistance of various woods, and wood to other materials. Through appropriate environmental testing, the total fracture energy was partitioned into two components. The first of these is the energy associated with wood acting purely as an elastic body; the second includes the energy to overcome vescoelastic effects.
KEYW Wood fracture, wood fracture resistance.

477 AUTH Potlatch Corporation
DATE 1952
TITL Pole blight: new threat to white pine.
PUBL The Family Tree. Lewiston, ID: Potlatch Corporation; 16: 3.
ABST Describes the discovery symptoms and danger of pole blight to western white pine in the Inland Empire.
KEYW Pole blight.

478 AUTH Powell, J. M.
DATE 1966
TITL Distribution and outbreaks of *Dendroctonus ponderosae* Hopk. in forests of western Canada.
PUBL Report A-X-2. Calgary, AB: Canadian Department of Environmental Information, Forest Research Laboratory. 19 p.
ABST Gives a general description of distribution and outbreaks of *D. ponderosae* in western Canada, including various outbreaks in *P. monticola.*
KEYW *Dendroctonus ponderosae*, British Columbia, distribution, outbreaks, *Pinus contorta, Pinus ponderosa, Picea engelmannii.*

479 AUTH Preston, J. F.
DATE 1924
TITL Forestry practice and possibilities in north Idaho.
PUBL The Timberman. 25: 49-50, 156-160.
ABST Describes silvicultural conditions, treatments, growth of trees, future prices.
KEYW Forest practices, forest management, silviculture.

480 AUTH Pryor, L. D.
DATE 1940
TITL The effect of fire on exotic conifers.
PUBL Australian Forester. 5: 37-38.
ABST Several species of exotic conifers, including western white pine, are ranked according to fire resistance at age 8 years. The importance of age, defoliation, and bark thickness as they relate to susceptibility to fire are discussed. The recurring ideas of interposing belts of resistant species at known danger points, and of using periodic control burns to prevent litter buildup are mentioned as possible management tools.
KEYW Exotic conifers, plantation, fire resistance, defoliation, cambium, epicormic shoots.

481 AUTH Raff, R. A. Y., Herrick, I. W., Adams, M. F.
DATE 1966
TITL Flame-retardant wood.
PUBL Forest Products Journal. 16: 43-47.
ABST The high energy irradiation of wood (western white pine) impregnated with unsaturated organophosphorus compounds is considered to be one application where the in situ radiation polymerization method can achieve an effect not otherwise obtainable. With even distribution of a flameproofing resin inside the wood, fire retardancy and leach resistance should result. Several commercially available organophosphorus monomers, some also containing halogen, were evaluated in this application. Only one of seven unsaturated phosphorus compounds was found to polymerize in a CO-60 source to a sizable extent, while all but one could be made to polymerize to a soft gel after 5 percent of a crosslinking monomer had been added. Western white pine, after impregnation in vacuo with any of these polymerizeable mixtures, followed by exposure to the gamma source, showed flameproofing properties in the crib test. The char remaining after combustion represented up to 58 percent of the impregnated wood samples. Photomicrographs of the char showed that the original wood structure was well preserved. After exposure in water for 14 days, the dried specimens still showed the same flame resistance as before leaching.
KEYW Flame-retardant, radiation polymerization, organophosphorus monomers.

482 AUTH Ramskill, J. H.
DATE 1934
TITL Thinning in the western white pine type.
PUBL Forestry Kaimin. Missoula, MT: University of Montana. p. 15-21.
ABST Some problems of thinning in the western white pine type of northern Idaho are discussed. Aside from possible increment increases, the pronounced improvement in stand quality resulting from a more desirable species mix should yield an increased financial return at maturity over unthinned stands. The extent to which this increase in value will cover the costs of thinning cannot be accurately discerned until final harvest. This article discusses thinning in terms of species desirability, basal area, trees per acre, cubic foot volume, spacing, crown classes, and other related factors.
KEYW Permanent plots, yield tables, thinning.

483 AUTH Rapraeger, E. F.
DATE 1936
TITL Effect of repeated ground fires upon stumpage returns in western white pine.
PUBL Journal of Forestry. 34: 715-718.
ABST The article describes three types of losses from ground fire: (1) understocking and reduced yield, (2) decay traceable to fire, and (3) roughness in trees. The author concludes that complete protection from fire is essential to growing quality western white pine.
KEYW Ground fire, stumpage, understocking, decay, roughness.

484 AUTH Rapraeger, E. F.
DATE 1936
TITL Relation of tree size in western white pine to log-making costs.
PUBL Applied Forestry Note 74. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Contains a graph comparing tree diameter to log-making costs (time expressed in man-minutes). The curves are based on time studies made near Orofino, ID, in a stand of western white pine timber 141 years of age.
KEYW Log cost, tree size.

485 AUTH Rapraeger, E. F.
DATE 1936
TITL What percent of tree volume is in each log of a western white pine tree?
PUBL Applied Forestry Note 75. Missoula, MT: U.S. Department of Agriculture, Forest

Service, Northern Rocky Mountain Forest and Range Experiment Station. 2 p.
ABST Gives tables showing percentage of gross volume contained in the butt log, second log, and other logs, including top log for western white pine trees approximately 140 years of age.
KEYW Log production, merchantable volume.

486 AUTH Rapraeger, E. F.
DATE 1938
TITL Results and application of a logging and milling study in the western white pine type of northern Idaho.
PUBL University of Idaho Bulletin. 33(16): 55.
ABST Data produced by a logging and milling study at the White Pine Lumber Company at Orofino, ID, and Clearwater National Forest are described and discussed. The effects of clearcutting and partial cutting are discussed. Data from time studies of various logging and milling elements are tabulated.
KEYW Cone crop tree diameter, crop tree dominance, milling, match plank, logging study, group cutting, partial cutting, clearcuts.

487 AUTH Rapraeger, E. F.
DATE 1939
TITL Development of branches and knots in western white pine.
PUBL Journal of Forestry. 37: 239-245.
ABST Two western white pines on Deception Creek Experimental Forest were studied to determine the development of branches and knots. It is suggested that increased stand density and pruning may decrease knotting.
KEYW Knots, stand density, branch size, branch longevity, knot length, pruning.

488 AUTH Rapraeger, E. F.
DATE 1939
TITL Log prices in the Northern Rocky Mountain Region.
PUBL Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The following statistics are given for western white pine from all Districts: quantity, 52,636 thousand bd ft log scale; average price per thousand bd ft, $18.49.
KEYW Log prices.

489 AUTH Rapraeger, E. F.
DATE 1939
TITL Matches from Idaho's white pine.
PUBL American Forester. 39(3): 1-3.
ABST Taking into account supply, price, and technical qualities, no wood in the United States is better suited for match manufacture than Idaho white pine. All important match companies draw their supply of match blocks from Idaho.
KEYW Products, matches.

490 AUTH Rapraeger, E. F.
DATE 1939
TITL Range of log prices, 1938 Northern Rocky Mountain Region.
PUBL The Timberman. 40(7): 28.
ABST For calendar year 1938, the following average log prices are given for western white pine: northeastern Washington - $16.11; St. Maries, Coeur d'Alene, Spokane - $19.00; Sandpoint - $17.12; Clearwater - $14.15; western Montana - $17.12; for an average of $18.49.
KEYW Log prices.

491 AUTH Rapraeger, E. F.
DATE 1939
TITL Results of a sawmill study of timber on ME plot 150 (Bearpaw Creek).
PUBL Unpublished report. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 33 p. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID.
ABST Results of a logging study on Bearpaw Creek, Kaniksu National Forest. Selling price of white pine and match plank, diameter growth data, and lumber yield are tabulated.
KEYW Tree growth, overrun, logging study, lumber yield crown class.

492 AUTH Rapraeger, E. F.
DATE 1939
TITL Tag ends of the logging and milling study at the White Pine Lumber Company operation at Orofino, Idaho.
PUBL Unpublished report. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 35 p. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID.
ABST Data produced by a logging and milling study at the White Pine Lumber Company at Orofino, ID, are tabulated and discussed. Production of match plank, effects of limb size, defect on match plank yields.
KEYW Milling, match plank, oversize sawing, overrun, sawing time.

493 AUTH Rapraeger, E. F.
DATE 1940

TITL Possibilities of partial cutting in young western white pine.
PUBL Paper 2. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 19 p.
ABST This paper deals with the technique of light cuts in young stands of western white pine. The technique involves at least three cuts: (1) A heavy thinning which takes about one-third of the volume in marketable trees 13.6 inches d.b.h. and larger. (2) A second cut when growth acceleration due to the initial cut begins to decline, probably from 10 to 20 years hence, taking about one-half of the remaining merchantable volume and leaving a shelterwood canopy. (3) A final cut to take the remainder of the stand after progeny have become well established, and to give release to regeneration. Advantages are listed as: release, accessibility, frequent cuttings, preservation of natural conditions, flexibility, early income, and better utilization.
KEYW Thinning, partial cutting.

494 AUTH Rehfeldt, G. E.
DATE 1979
TITL Ecotypic differentiation in populations of *Pinus monticola* in north Idaho—myth or reality?
PUBL American Naturalist. 114: 627-636.
ABST Full-sib families representing 12 populations of *Pinus monticola* were compared to assess local differentiation of populations in northern Idaho. Populations represented north and south aspects at three elevations (950, 1,175, and 1,400 m) in each of two drainages. Tests of 6-year-old seedlings growing in two contrasting environments revealed (1) little or no differentiation among populations, (2) genetic variation among families within populations, and (3) large environmental effects on growth and development. These results and other recent data suggest that adaptation of *P. monticola* to variable environments is governed more by phenotypic plasticity than by selective differentiation.
KEYW Ecotypic variation, phenotypic plasticity, provenance test

495 AUTH Rehfeldt, G. E., Hoff, R. J.
DATE 1977
TITL Proper seed source—a key to planting success.
PUBL In: Baumgartner, D. M.; Boyd, R. J., eds. Tree planting in the Inland Northwest. Pullman, WA: Washington State University Cooperative Extension Service. p. 43-48.
ABST The need for planting seedlings that are adapted to the site is discussed. Western white pine, Douglas-fir, and ponderosa pine are given as examples.
KEYW Seed source, seed transfer, provenance tests.

496 AUTH Rehfeldt, G. E., Hoff, R. J., Steinhoff, R. J.
DATE 1984
TITL Geographic patterns of genetic variation in *Pinus monticola*.
PUBL Botanical Gazette. 145(2): 229-239.
ABST Genetic differentiation of 59 populations representing the geographic distribution of *Pinus monticola* was studied in field, greenhouse, and laboratory tests. Geographic variation was described by regression models, which accounted for as much as 85 percent of the variance among populations. Populations from the north (Rocky Mountains, northern Cascades, and northern coastal areas) are generally of high growth potential and low cold hardiness. Southern populations (Sierra Nevada) exhibit low growth potential and high hardiness. Populations from the central and southern Cascades are arranged along relatively steep latitudinal clines that connect northern and southern groups. Although differentiation within the transitional region was readily detected, patterns of variation within northern and southern regions were either weak or nonexistent. Nowhere was genetic variation related to the elevation of the seed source.
KEYW Provenance test.

497 AUTH Rehfeldt, G. E., Stage, A. R., Bingham, R. T.
DATE 1971
TITL Strobili development in western white pine: periodicity, prediction, and association with weather.
PUBL Forest Science. 17: 454-461.
ABST Variation in yearly counts of female strobili during various stages of development was studied from 18-year records of four trees in northern Idaho. Spectral analyses indicated that periodicity in production of strobili by individual trees followed major cycles of 4 years; cycles of 3 years were of secondary importance. Cospectral analyses indicated that cycles of the four trees were in phase. Autoregression was used to develop models for predicting strobili production. Regressions involving lags of 4 years in the dependent variable accounted for 47 and 41 percent of the variation in counts of immature and mature strobili, respectively. Association of strobili production with daily moisture stress indicated: (1) water deficits during early summer of the year in which strobili matured were directly related to abortion of strobili; (2) moisture stresses during early summer of the first and second

years preceding emergence of strobili from the bud scales were associated with high strobili counts; and (3) water deficits during late summer in the year preceding strobili emergence were detrimental to strobili development.

KEYW Cone production, cone prediction, moisture stress.

498 AUTH Rehfeldt, G. E., Steinhoff, R. J.
DATE 1970
TITL Height growth in western white pine progenies.
PUBL Research Note INT-123. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Heights of 31 progenies of western white pines from four geographic localities and four crosses between localities were assessed on 14-year-old trees at two sites. Differences in height among individual progenies were detected but could not be related to localities or crosses between localities. Although differential effects of sites on tree height became apparent after age 9, differences among progenies were similar on both sites.
KEYW Height growth.

499 AUTH Rettig, E. C.
DATE 1942
TITL Cutting practices.
PUBL Journal of Forestry. 70: 366-367.
ABST Reviews cutting practices of Potlatch Forests, Inc., in Clearwater County, ID. Shelterwood cutting was the principal method used in young stands; seed tree method was used in mature stands.
KEYW Cutting practices, shelterwood cut, seed tree cut, slash disposal.

500 AUTH Righter, F. I.
DATE 1945
TITL *Pinus*: the relationship of seed size and seedling size to inherent vigor.
PUBL Journal of Forestry. 43: 131-137.
ABST In several experiments the author has endeavored to isolate and evaluate some of the factors ordinarily associated with vigor in pines. He concludes that seed size and seedling size are controlled more by environment than by heredity and cannot therefore be used as indicators of inherent vigor.
KEYW Seed size, seedling size, inherent vigor, *Pinus monticola* x *P. strobus*, seed weight.

501 AUTH Righter, F. I., Duffield, J. W.
DATE 1951
TITL Interspecies hybrids of pines.
PUBL Heredity. 42: 75-80.
ABST This article lists all pine hybrids which resulted in successful pollination at the Institute of Forest Genetics. *P. monticola* seed parents crossed with the following pollen parents were successful: *P. ayacahuite, P. peuce*, (*P. peuce* x *P. strobus*).
KEYW Hybrids, *Pinus monticola* x *P. griffithii*, *Pinus monticola* x *P. ayacahuite, Pinus monticola* x *P. peuce, Pinus monticola* x (*P. peuce* x *P. strobus*).

502 AUTH Rigkey, R. G., Hergert, H. L.
DATE 1974
TITL Reactions in pine heartwood during acid bisulfite pulping.
PUBL Tappi. 57(7): 114-117.
ABST Heartwood of a variety of pine species was experimentally pulped by the acid bisulfite process. Results varied from complete pulpability to no "pulping" whatsoever. Qualitative analyses for pinosylvin and related stilbenes, pulping inhibitors, showed them to be present in all species examined. Quantitative analyses indicated wide variation in the amounts of these compounds. A mechanism for the pulping inhibition is proposed.
KEYW Heartwood, acid bisulfite process, pulpability, pulping inhibitors.

503 AUTH Roberts, V. K.
DATE 1966
TITL A bibliography of publications by the Intermountain Forest and Range Experiment Station on the genetics and breeding of forest trees, 1921-1965.
PUBL Research Note INT-48. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 8 p.
ABST Lists all genetics publications of the Intermountain Station between 1921 and 1965. Many of these publications deal with western white pine, especially its resistance to blister rust.
KEYW Bibliography, genetics, breeding.

504 AUTH Robinson-Jeffrey, R. C., Davidson, R. W.
DATE 1968
TITL Three new Europhium species with *Verticicladiella* imperfect states on blue-stained pine.
PUBL Canadian Journal of Botany. 46: 1523-1527.
ABST Three new species in the genus *Europhium* (*E. clavigerum, E. aureum,* and *E. robustum*) with *Verticicladiella* imperfect states are described and figured. *Cleistothecia* are found on bark, sapwood, and in old beetle galleries of beetle-infested, blue-stained pines, including lodgepole, ponderosa, limber, and western white. *Europhium clavigerum* was found on all hosts, *E. aureum* on lodgepole,

and *E. robustum* on differences between the imperfect states. A key is provided to separate the *Verticicladiella* states of the three new species of *Europhium* and the *Leptographium* state of *E. trinacriforme*.

KEYW *Europhium claviaerum, Europhium aureum, Europhium rubustum, Verticicladiella, Leptographium, Europhium trinacriforme,* blue stain.

505 AUTH Rockwell, F. I.
DATE 1913
TITL Basis of classification into forest types and its application to District 1.
PUBL Society of American Foresters Proceedings. 8: 85-90.
ABST Describes methods of classifying forest types in forests of Idaho, Montana, and eastern Washington. Four types are discussed—temporary, climax, cover, and physical.
KEYW Forest types, climax type, cover type, physical type.

506 AUTH Rockwell, F. I.
DATE 1916
TITL White pine in four northwestern States estimated at 27,970,000,000 feet.
PUBL West Coast Lumberman. 31(360): 20-21.
ABST Tabulates the board feet of white pine in Washington, Oregon, Idaho, and Montana. Lists the yield of various diameters of white pine per acre.
KEYW Merchantable stand, board feet by state, board feet per acre by diameter.

507 AUTH Rockwell, F. I.
DATE 1920
TITL Diseases: *Pinus monticola*.
PUBL Unpublished manuscript (carbon copy) on file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Forestry Science Laboratory, Moscow, ID. 22 p.
ABST Diseases of western white pine are briefly described as they are induced by various external injuries, atmospheric influences, soil, cryptogamic plants, and animals.
KEYW Disease survey, fire, blue stain, soil conditions, frost injury, high temperatures, drought, bark scorching, snow damage, lightning, *Trametes pini, Polyporus sulphureus, Fomes pinicola, Fomes laricis, Polyporus schweinitzii, Fomes annosus, Armillaria mellea, Lophodermium pinastri,* lichen damage, *Usnea barbata, Usnea longissima, Alectroia fremontii,* yellow bellied sapsucker, rednaped sapsucker, *Rodentia*.

508 AUTH Roff, J. W., Shen, H.
DATE 1959
TITL Loss in stiffness evaluates decay resistance of wood treated with copper naphthenate.
PUBL Forest Products Journal. 9: 262-265.
ABST Inception of wood decay was measured by loss in stiffness of western white pine beams exposed to wood-destroying fungi. Results of bending tests on material treated with copper naphthenate showed that a concentration of 5 percent by weight of copper applied by dipping inhibited most test organisms. Reduction in strength, indicated by increased deflection, showed failure of treatments often when there was no weight loss in the wood.
KEYW Decay resistance, copper naphthenate, deflection, wood decay.

509 AUTH Rogers, E. C.
DATE 1917
TITL Delayed germination among five-needled pines with particular reference to *Pinus monticola* Dougl.
PUBL Ithaca, NY: Cornell University. 73 p. M.S. thesis.
ABST The use of sulfuric acid, potassium permanganate, or hydrogen peroxide did not increase germination. Seed collection date did not influence germinative energy. Cutting the seed coat of the radicle end resulted in prompt germination of 20 to 50 percent of the seed.
KEYW Seed germination, delayed germination.

510 AUTH Rogers, J. D.
DATE 1967
TITL A study of fungi associated with the decomposition of coniferous litter.
PUBL Pullman, WA: Washington State University. Ph.D. thesis. [Dissertation abstracts 27b: 2959.]
ABST The kinds and successions of fungi associated with decomposition of litter under *Abies grandis, Pinus monticola,* and *P. ponderosa* on sites located in Latah County, ID, were studied. A total of 151 species of fungi were isolated from A0 and A1 soil horizon materials. These included: 125 *Fungi imperfecti,* 13 *Ascomycetes,* and 10 species of *Phycomycetes*.
KEYW Litter, soil fungi, *Fungi imperfecti, Ascomycetes, Phycomycetes*.

511 AUTH Rothermel, R. C., Anderson, H. E.
DATE 1966
TITL Fire spread characteristics determined in the laboratory.
PUBL Research Paper INT-30. Ogden, UT: U.S. Department of Agriculture, Forest Service,

Intermountain Forest and Range Experiment Station. 34 p.

ABST Fire spread characteristics of western white pine and ponderosa pine needles at different moisture levels and different wind velocities were tested under controlled conditions. Some conclusions were: (1) As wind increased, the fire spread at an increasing rate; (2) the fire was carried in the surface fuel particles; (3) flame depth increased and vertical depth of burn decreased as windspeed increased; (4) in the absence of wind, rate of spread decreased linearly as fuel moisture increased.

KEYW Fire spread, fuel moisture, wind, fuel beds, flame size, pine needles.

512 AUTH Ryker, R. A., Pfister, R. D.
DATE 1967
TITL Thinning and fertilizing increase growth in a western white pine seed production area.
PUBL Research Note INT-56. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST Thinning increased diameter growth of 40-year-old western white pine trees by 39 percent. Fertilizing with N and NPK had no effect in unthinned plots, but caused an additional increase of 36 percent in diameter growth in thinned plots. Height growth was not affected by thinning and fertilizing.
KEYW Thinning, fertilization, seed production, diameter growth, height growth.

513 AUTH Saho, H.
DATE 1972
TITL White pines of Japan.
PUBL In: Biology of rust resistance in forest trees. Miscellaneous Publication 1221. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 179-199.
ABST Native *Pinus pentaphylla* from cool, rocky sites of northern Japan and *P. himekomatsu* from similar mountainous sites to the south both exhibit slower growth but higher needle-rust and rodent-damage resistance than introduced *P. strobus*. The often dwarf and very slow-growing *P. pumila* occupies mountaintop sites throughout northern and central Japan and is quite resistant to needle rusts. *P. koraiensis,* limited almost entirely to the central mountains of Honshu, exhibits growth slightly better than *P. pentaphylla,* but still well below that of *P. strobus*. It is highly susceptible to needle rusts. *Pinus strobus* is the preferred white pine introduction, but if vole populations are high, control of these rodents is required. Only limited information was available on *P. monticola, P. griffithii, P. albicaulis, P. flexilis,* and *P. lambertiana.*
KEYW Native Japanese white pine, needle rust resistance, growth.

514 AUTH Santamour, F. S., Jr.
DATE 1960
TITL New chromosome counts in *Pinus* and *Picea*.
PUBL Silvae Genetica. 9: 87-88.
ABST Chromosome counts made with endosperm (female gametophyte) tissue showed a chromosome number of n=12 for *Pinus monticola* and other haploxylon pines.
KEYW Cytology, chromosome count.

515 AUTH Santamour, F. S., Jr.
DATE 1965
TITL Insect-induced crystallization of white pine resins. I. White-pine weevil.
PUBL Research Note NE-38. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 8 p.
ABST Shoot oleoresins of *P. monticola* were readily crystallized in the presence of crushed heads of weevil larvae. The relationship between weevil-induced resin crystallization and susceptibility to weevil attack is not clear.
KEYW White-pine weevil, crystallization, oleoresin, monoterpenes, weevil larvae, *Pissodes approximatus*, *Pissodes strobi* x *approximatus,* white pine species, white pine hybrids.

516 AUTH Santamour, F. S., Jr.
DATE 1965
TITL Insect-induced crystallization of white pine resins. II. White-pine cone beetle.
PUBL Research Note NE-39. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 5 p.
ABST The resistance of *P. monticola* to insect-induced resin crystallization was not exhibited in the control-pollinated hybrids tested. However, the results suggest that *P. monticola* and *P. peuce* may contribute some degree of resistance to the beetle.
KEYW Oleoresin, crystallization, white pine cone beetle, *Conophthorus coniperda*, resistance.

517 AUTH Satterlund, D. R., Haupt, H. F.
DATE 1967
TITL Snow catch by conifer crowns.
PUBL Water Resources Research. 3: 1035-1039.
ABST Study of interception storage of snow by two species of sapling conifers in northern Idaho revealed that cumulative snow catch follows the classical law of autocatakinetic growth. Interception storage conformed to the law in five storms in which snowfall began while the trees were bare and in two storms in which snow fell while snow from

previous storms persisted on the trees. Several small storms yielded insufficient data to define the appropriate constants, but inspection indicated no serious deviation from the general law.

KEYW Interception, snow, conifer crowns.

518 AUTH Satterlund, D. R., Haupt, H. F.
DATE 1970
TITL The disposition of snow caught by conifer crowns.
PUBL Water Resources Research. 6: 649-652.
ABST Snow interception studies during the warm winters of 1966-67 and 1967-68 in northern Idaho revealed that Douglas-fir and western white pine saplings caught about one-third of the snow that fell in 22 storms. More than 80 percent of the snow initially caught in the crowns ultimately reached the ground by being washed off by subsequent rain, falling by direct mass release, or dripping as melting snow. Only a small portion was lost by evaporation.
KEYW Snow disposition, snow interception, tree crown.

519 AUTH Schafer, E. R., Hyttinen, A., Martin, J. S.
DATE 1960
TITL The groundwood and sulfate pulping of pole-blighted and healthy western white pine.
PUBL Report FPL-2185. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 14 p.
ABST Groundwood and sulfate pulping experiments were made on wood from healthy and pole-blighted western white pine. Pulps of good quality can be produced from both types, although those made from the healthy trees were, on the average, slightly higher in strength than those from the pole-blighted trees.
KEYW Groundwood pulping, sulfate pulping, pole blight, stand composition, physical characteristics, chemical analysis, pulp strength.

520 AUTH Schenk, J. A., Goyer, R. A.
DATE 1967
TITL Cone and seed insects of western white pine in northern Idaho: distribution and seed losses in relation to stand density.
PUBL Journal of Forestry. 65: 186-187.
ABST An adequate seed source is necessary to supply seed for the increasing number of forest plantations being established by public and private agencies in the Western United States. Thus, as the demand for forest tree seed has increased, the effects of insects on its production and collection has become of vital concern. Previous examinations of cones from western white pine plantations indicated that relatively heavier infestations occur in low-density than in high-density stands. The results of a study initiated in 1963 to more fully investigate this relationship are reported here.
KEYW Cone insects, seed insects, *Eucosma rescissoriana, Dioryctria abietella, Conophthorus monticolae.*

521 AUTH Schmidt, W. C., Lotan, J. E.
DATE 1980
TITL Phenology of common forest flora of the Northern Rockies—1928 to 1937.
PUBL Research Paper INT-259. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 20 p.
ABST This paper presents 10 years of phenological observations of common forest flora of the Northern Rockies. Descriptions of important phenological events and earliest, latest, and average dates of their occurrence are included. Phenological data were collected on many National Forests, as well as Yellowstone and Glacier National Parks, at more than 40 locations ranging from eastern Montana to northern Idaho. Summaries include 50 forest species—13 conifers, 22 hardwood trees and shrubs, and 15 herbaceous plants. Six summary tables are used to stratify the phenological information for the above three vegetation groupings both east and west of the Continental Divide. This phenological information has the potential for much practical application where timing of events such as leafing, pollination, cone opening, and others are key to scheduling specific management and research activities.
KEYW Phenological observations, native plants.

522 AUTH Schopmeyer, C. S.
DATE 1938
TITL Brushfield reforestation in the St. Joe National Forest, Idaho.
PUBL Applied Forestry Note 83. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Two reforestation methods (clearing strips with a bulldozer and broadcast burning) are compared. The stock of western white pine planted in 1937 showed nearly 100 percent survival after one growing season on both the burned area and the natural brush. On the stripped area survival was only 82 percent. Seedlings in natural brush did not appear as vigorous as those on the burned area.
KEYW Reforestation, broadcast burning, bulldozer clearing.

523 AUTH Schopmeyer, C. S.
DATE 1939
TITL Direct seeding in the western white pine type.
PUBL Applied Forestry Note 90. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The relative success of these studies is attributed to adequate protection of seed spots against rodents and to the selection of more favorable sites. Fall sowing of seed of all species resulted in average germination of 60 percent; germination of spring sown seed was not more than 25 percent. Spring-sown white pine seed had less than 5 percent germination, probably due to failure of stratification treatment.
KEYW Direct seeding, seed stratification, seed germination, seed spots.

524 AUTH Schopmeyer, C. S.
DATE 1940
TITL Second-year results of direct-seeding experiments in the western white pine type using screens for rodent control.
PUBL Research Note 6. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 7 p.
ABST Results 2 years after sowing demonstrate the possibility of using direct seeding as a method of reforestation in the western white pine type. Cultivation of seed spots previous to sowing results in no better stocking than that obtained by sowing seed in undisturbed mineral soil after removing ashes and duff. Average stocking from fall sowing was 17 percent greater than from spring sowing. The use of conical screens for protection of fall-sown western white pine seed resulted in three times the percentage of successful seed spots.
KEYW Direct seeding, fall sowing, spring sowing.

525 AUTH Schopmeyer, C. S.
DATE 1940
TITL Successful forestation by direct seeding using poisons for rodent control.
PUBL Research Note 1. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Rodent control was obtained by prepoisoning areas to be direct seeded. Poison consisted of hulled sunflower seed treated with thallium sulfate (one part to 100 parts of seed by weight). In addition, seed to be sown was treated with a mixture of 48 percent yellow dextrine, 34 percent plaster of paris, 15 percent cornmeal, and 3 percent strychnine alkaloid. In the small tests described here, this method proved effective, practical, and economical.
KEYW Rodent control, reforestation, direct seeding, planting costs.

526 AUTH Schopmeyer, C. S.
DATE 1940
TITL Survival in forest plantations in the Northern Rocky Mountain Region.
PUBL Journal of Forestry. 38: 16-24.
ABST During the period 1910-37, a total of 1,150 plantations were established on an aggregate area of 93,878 acres in western Montana, northern Idaho, and northeastern Washington. The means of all recorded first-year survival percentages of spring-planted western white pine and ponderosa pine trees are 7 and 10 percent higher, respectively, than those of fall-planted trees of the same species. An analysis of all available first- and third-year survival data on plantations of various age classes of planting stock showed that there are no significant differences in survival between age classes of stock of either western white pine or ponderosa pine. The mean tenth-year survival percentage of 210 plantations distributed over the region on an aggregate area of 29,589 acres is 42 percent.
KEYW Plantation survival, nursery practices, planting practices, spring planting, fall planting.

527 AUTH Schopmeyer, C. S., Helmers, A. E.
DATE 1947
TITL Seeding as a means of reforestation in the Northern Rocky Mountain Region.
PUBL Circular 772. Washington, DC: U.S. Department of Agriculture. 31 p.
ABST These experiments with direct seeding were initiated to develop methods to supplement and increase the flexibility of, or lower the cost of, the reforestation program. Western white pine was successfully spot-sown on freshly burned north-facing slopes and flats within the western white pine type where protection from rodents was provided. Effective control of rodents was attained either by using conical wire screens over seed spots or by spreading poisoned bait 1 week prior to seeding. The number of seedlings established by the spot-sowing method compared favorably with the number of nursery-grown trees established by planting. Fall sowing of western white pine, ponderosa pine, Engelmann spruce, and western redcedar resulted in better initial stocking than spring sowing. Cultivation of seed spots at the time of sowing on burned-over areas did not improve the germination or survival of

western white pine, ponderosa pine, and Engelmann spruce. A single test of broadcast-sown western white pine attained higher stocking than spot-sown white pine.

KEYW Reforestation, spot sowing, broadcast sowing, rodent control, fall sowing, spring sowing, cultivation, direct seeding.

528 AUTH Schubert, G. H.
DATE 1952
TITL Germination of various coniferous seeds after cold storage.
PUBL Research Note PSW-83. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 7 p.
ABST Seeds were air-dried, then stored in airtight containers at 41 °F for periods from 2 to 24 years. They were then stratified in moist sand and peat moss for 60 days at 36 °F. *Pinus monticola* in storage for 16 years had 35 percent germination; that stored for 15 years had 40 percent germination. However, stratification time may not have been sufficient.
KEYW Seeds, cold storage, seed storage, seed germination.

529 AUTH Schubert, G. H.
DATE 1954
TITL Viability of various conifer seeds after cold storage.
PUBL Journal of Forestry. 52: 446-447.
ABST Germination of seeds from 42 species of conifers after prolonged cold storage (41 °F) is summarized. Percentage viability for *Pinus monticola* was: 0-5 years (2 seed lots), 62 percent; 11-20 years (4 seed lots), 20-40 percent.
KEYW Seed viability, seed germination, seed storage.

530 AUTH Seikel, M. K., Hall, S. S., Feldman, L. C., Koeppen, R. C.
DATE 1965
TITL Chemotaxonomy as an aid in differentiating wood of eastern and western white pine.
PUBL American Journal of Botany. 52: 1046-1049.
ABST Heartwoods from *Pinus strobus* (eastern white pine) and *Pinus monticola* (western white pine), which are difficult to distinguish anatomically, can be separated with about 95 percent accuracy by subjecting their acetone extracts to simple paper chromatography. Basically, this differentiation is possible because the relative proportions of certain flavanones vary in the two species, and when these are treated with the chromogenic spray, distinguishing colors are produced at different rates of speed. With *P. strobus*, the characteristic yellowish-orange spot results from higher percentages of cryptostrobin and strobobanksin; the pinkish-red spot, typical of *P. monticola* extract, is due to a preponderance of pinocembrin.
KEYW Heartwood chemicals.

531 AUTH Shaw, C. G., Leaphart, C. D.
DATE 1960
TITL Two serious foliage diseases of western white pine in the Inland Empire.
PUBL Plant Disease Reporter. 44: 655-659.
ABST Two diseases not previously differentiated are reported on western white pine from Idaho. Needle cast, caused by *Hypodermella arcuata* Darker, occurs primarily in the upper crown. Needle blight, with which a species of *Lecanosticta* is associated, is most prevalent in the lower crowns of infected trees. The sequence of development of symptoms and of the associated organisms is outlined for the two diseases.
KEYW Foliage diseases, needle cast, *Hypodermella arcuata*, needle blight, *Lecanosticta.*

532 AUTH Shaw, C. G., Thyr, B. D.
DATE 1962
TITL Observations on diseases of coniferous foliage in the Inland Empire.
PUBL Phytopathology. 52: 365. Abstract.
ABST Among other observations, it is noted that *Hypodermella arcuata*, epidemic in 1959, was less prevalent in 1960. Analysis of weather data indicated a correlation between infection and precipitation during the period of ascosporic discharge in July and August.
KEYW *Hypodermella arcuata.*

533 AUTH Shaw, C. H.
DATE 1916
TITL The vegetation of the Selkirks.
PUBL Botanical Gazette. 61: 477.
ABST This article, compiled from his notes after Dr. Shaw's death, gives an overall summary of the vegetation of the Selkirk Mountains. Dr. Shaw listed *Pinus monticola* as a principal species of the area, but as less prominent in an early phase of reforestation after a burn. He stated that nowhere was it very abundant, but it was becoming a valuable timber tree in the hemlock district.
KEYW Vegetation classification, Selkirk Mountains, reforestation.

534 AUTH Shifrine, M., Phaff, H. J.
DATE 1956
TITL The association of yeasts with certain bark beetles.
PUBL Mycologia. 48(1): 41-55.

ABST This paper summarizes a survey of the yeasts associated internally with various species of the bark beetle genera *Dendroctonus* and *Ips*, collected from five different species of pine. A total of 169 yeasts were identified. *Saccharomyces pini* is the most common yeast associate of *Dendroctonus brevicomis*, and *Candida silvicula* is most prevalent in *Ips oregoni*. All three major species of yeasts were isolated from *P. monticola*. Typical physiological properties of the yeast isolates are discussed.
KEYW Bark beetles, host trees, yeasts, *Dendroctonus*, *Ips*.

535 AUTH Simeone, J. B., MacAndrews, A. H.
DATE 1955
TITL The old house borer in New York State.
PUBL Journal of Economic Entomology. 48(6): 753-754.
ABST The establishment of the old house borer (*Hylotrupes bajulus*) as a serious pest of wood structures in Northeastern United States has been of growing concern. Since 1900, several collections of the old house borer have been made in New York State by various workers. This article reports some additional records which were communicated to the authors.
KEYW *Hylotrupes bajulus*, insect pest, wood structures.

536 AUTH Skeels, D.
DATE 1927
TITL Compulsory slash disposal in Montana.
PUBL The Timberman. 28: 178-182.
ABST A new law to cover the disposal of slash was considered in Montana. This article covers the various needs for a law, the various methods of slash disposal, laws in Idaho, and experimental laws.
KEYW Slash disposal, forest legislation.

537 AUTH Smith, J. H. G., Ker, J. W.
DATE 1957
TITL Timber volume depends on D^2H.
PUBL British Columbia Lumberman. 1957(9): 28-30.
ABST Combined-variable equations are presented as a simplified alternative to the original logarithmic tree volume relationships used to estimate cubic foot volume of commercial British Columbia species.
KEYW Cubic foot volume tables, combined variable formula.

538 AUTH Smith, R. H.
DATE 1963
TITL Toxicity of pine resin vapors to three species of *Dendroctonus* bark beetles.
PUBL Journal of Economic Entomology. 56: 827-831.
ABST The vapor toxicity of saturated resin vapors of both host and nonhost pines was determined for three species of *Dendroctonus*: *D. brevicomis*, *D. ponderosae*, and *D. jeffreyi*. Results with hard pines substantiate the hypothesis that bark beetles of this genus can tolerate saturated vapors of host resin but not of nonhost resin, suggesting that resin is a determining factor in host specificity. Results with soft pines do not substantiate the hypothesis, suggesting that other properties of resin or nonresinous characteristics of these pines determine host specificity. A delayed effect in many tests with hard pine host resin suggests that even host resins can be deleterious under certain conditions. Variable results were obtained with hybrid pines. The overall results suggest that resin in some capacity may be an important factor in host resistance.
KEYW *Dendroctonus brevicomis*, *Dendroctonus ponderosae*, *Dendroctonus jeffreyi*, resin vapor toxicity.

539 AUTH Smythge, R. V., Coppel, H. C., Lipton, S. H., Strong, F. M.
DATE 1967
TITL Chemical studies of attractants with *Reticulitermes flavipes* and *R. virginicus*.
PUBL Journal of Economic Entomology. 60: 228-233.
ABST Both the eastern subterranean termite (*Reticulitermes flavipes*) and *R. virginicus* have an abdominal gland which secretes a compound inducing trail-following and other attractant behavior in either species. Purification of the compound carried through one gas-liquid chromatographic run gave a product active at 0.1 mg. Western white pine rotted by the fungus *Lenzites trabea* produced trail-following with material from 100 micrograms of wood per mL of test solution. On a weight basis, *L. trabea*-rotted wood is approximately 20 times as rich a source of attractant as the termites themselves. When the product from wood was gas chromatographed, the active region corresponded in retention time to that found for the gland substance.
KEYW Attractants, *Reticulitermes flavipes*, *Reticulitermes virginicus*, *Lenzites trabea*.

540 AUTH Snellgrove, T. A., Fahey, T. D.
DATE 1977
TITL Market values and problems associated with utilization of dead timber.
PUBL Forest Products Journal. 27(10): 74-79.
ABST Dead timber suffers a series of incremental losses: (1) logging and handling losses in the

woods and mill yard, (2) decreased lumber volume from logs sawed, and (3) degrade of lumber due to deterioration defects. Dollars per hundred cubic feet of gross tree volume is used to express value losses. A number of factors can affect utilization of dead timber. These include inherent bias against utilization, handling problems created by increased breakage, manufacturing problems in mills, and market considerations.

KEYW Dead timber, utilization, product potential, losses, economic opportunity.

541 AUTH Snellgrove, T. A., Plank, M. E., Lane, P. H.
DATE 1970
TITL An improved system for estimating the value of western white pine.
PUBL Research Paper PNW-166. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 19 p.
ABST This report describes an improved system for estimating the lumber selling value or volume of western white pine sawtimber. The model developed contains six tree characteristics: (1) tree diameter, (2) tree height, (3) height to the first live limb, (4) the number of limb-free and defect-free faces in the butt 16-foot log, (5) diameter of the largest limb in the butt 16-foot log, and (6) total tree defect percent. The prediction equation, using those six characteristics, accounts for 94 percent of the variation in tree value and 95 percent of the variation in lumber tally volume as measured by the regression values. The system is faster and more objective than log grading and has the additional advantage of eliminating grouping error by being a continuous predictor.
KEYW Tree value estimates, tree volume estimates, grading system.

542 AUTH Snyder, G. G., Haupt, H. F., Belt, G. H.
DATE 1975
TITL Clearcutting and burning slash alter quality of stream water in northern Idaho.
PUBL Research Paper INT-168. Ogden, UT: U.S. Department of Agriculture. Forest Service, Intermountain Forest and Range Experiment Station. 34 p.
ABST Reports the results of a 21-month study of changes in the quality of streamwater after clear felling and prescribed burning of slash on three areas in a *Pinus monticola / Thuja plicata / Pseudotsuga menziesii / Larix occidentalis* forest. Significant increases in pH, electrical conductivity, turbidity, suspended solids, HCO_3, SO_4, K, Ca, and Mg occurred in sections of the streams within the clear-felled areas, but changes between stations above and below the clear-felled areas were within the limits of the U.S. Public Health Service standards for drinking water.
KEYW Clearcut, water quality.

543 AUTH Soles, R. L., Gerhold, H. D.
DATE 1970
TITL Development and evaluation of methods for selecting pines for resistance to the white-pine weevil.
PUBL School of Forestry Research Briefs. University Park, PA: Pennsylvania State University; 4(4): 49-52.
ABST Attack by weevils was compared between eastern white pine and western white pine, a resistant host. Results suggest that resistance mechanisms of western white pine either inhibit the weevils from traveling to the trees or induce them to leave. No differences after attack were noted.
KEYW Resistance weevil.

544 AUTH Soles, R. L., Gerhold, H. D., Palpant, E. H.
DATE 1969
TITL Testing white pine seedlings for weevil resistance.
PUBL In: 2d FAO/IUFRO world consultation on forest tree breeding; FO-FTB-69-5/9. 4 p.
ABST Experiments were conducted to determine the feasibility of screening small pine seedlings in cages for resistance to the white-pine weevil, *Pissodes strobi*. The weevils showed normal host attack behavior in all stages of their life cycle and were able to discriminate differences in susceptibility among various provenances of eastern white pine (*Pinus strobus*) and among eastern white pine, western white pine (*Pinus monticola*), and Himalayan white pine (*Pinus griffithii*). Varying intensities of selection against seedlings susceptible to weevil attack were obtained by manipulation of weevil population density, weevil population sex ratio, and date of exposure. The results show that caged white pine seedlings can be successfully tested for their weevil resistance when between 2 and 5 years old. A population density of about one male plus one female per tree, or of two females per tree, should be introduced into the cages containing trees soon after the weevils become active in the spring. An exposure period of 2 weeks should yield differences among seedlings in adult feeding and larval-caused leader mortality that permits elimination of 25 percent of the seedlings. The seedlings may be exposed to weevil attack each year for years, and the more resistant seedlings can then be outplanted for further resistance evaluations.
KEYW Weevil resistance, insect resistance, *Pissodes strobi*.

545 AUTH Soles, R. L., Gerhold, H. D., Palpant, E. H.
DATE 1970
TITL Resistance of western white pine to white-pine weevil.
PUBL Journal of Forestry. 68: 766-768.
ABST Western white pine is resistant to attack by the white pine weevil (*Pissodes strobi*). Adult weevils were caged on trees of eastern white pine and western white pine; indices of attack were used to determine which stages of the life cycle of the weevil were affected by resistance mechanisms. Adult weevil mortality was negligible for both species; the numbers of feeding cavities on *P. monticola* were greater than on *P. strobus*. Numbers of adult emergence holes and leader mortality were similar for both species. The results suggest that resistance mechanisms of *P. monticola* either inhibit the weevils from traveling to the trees or induce them to leave.
KEYW White pine weevil, *Pissodes strobi*, weevil resistance, leader mortality.

546 AUTH Spokesman Review.
DATE 1952
TITL Blight's threat still mystery.
PUBL The Spokesman Review. 1952 June 17: p. 5, col. 1.
ABST An interview with C. A. Wellner concerning pole blight.
KEYW Pole blight.

547 AUTH Squillace, A. E.
DATE 1952
TITL Opportunities for forest genetics research in the Northern Rocky Mountain Region.
PUBL Montana Academy of Science Proceedings. 11: 3-7.
ABST The current project with western white pine is the blister-rust-resistant white pine breeding project, a cooperative venture of the Bureau of Entomology and Plant Quarantine and the United States Forest Service. Fifty-nine trees with apparent resistance to blister rust have been located in northern Idaho and are being crossed by controlled pollination, or vegetatively propagated. Hybridization tests include *Pinus monticola* x *P. strobus* and *P. monticola* x *P. griffithii*.
KEYW Blister rust resistance, vegetative propagation, hybridization, *Pinus monticola* x *P. strobus*, *Pinus monticola* x *P. griffithii*.

548 AUTH Squillace, A. E.
DATE 1954
TITL Forest genetics research in the Northern Rocky Mountain Region.
PUBL Journal of Forestry. 52: 691-692.
ABST The following investigations concern western white pine: blister-rust-resistant western white pine; investigations of self-fertility and self-compatibility in western white pine; vegetative propagation techniques; hybridization and field testing of hybrids; development of a strain of ponderosa pine suitable for planting as a substitute for western white pine.
KEYW Self fertility, self compatibility, vegetative propagation, hybridization.

549 AUTH Squillace, A. E.
DATE 1957
TITL Variations in cone properties, seed yield and seed weight in western white pine when pollination is controlled.
PUBL Bulletin 5. Missoula, MT: Montana State University, School of Forestry. 16 p.
ABST Two tests were conducted to study factors associated with within-tree variation in cone characteristics, seed yield, and seed weight in western white pine, during the period 1952-54. In these tests 149 cones were produced through specially designed, intraspecific controlled pollinations on eight trees growing in northern Idaho. Within-tree variations in cone length and average seed weight by cones were found to be associated with factors peculiar to the particular shoots on which the cones are borne. Seeds borne on shoots in the upper and outer crown and on the south and west sides tended to be heavier than those in opposing portions of the crown. Cones borne on the more fruitful shoots tended to be longer and contained heavier seeds than those on the less fruitful shoots. Metaxenial effects upon the ratio of cone-scale width to scale length were rather definitely shown. Similar effects were also noted upon cone length, ratio of average scale size to cone length, and seed weight, but they did not occur in a sufficient number of cases, or the evidences were not strong enough, to establish conclusively such effects. The putative metaxenial effects were usually small and often easily obscured by environmental influences. Sound seed yield was often directly correlated with cone length. Average seed weight by cones was directly correlated with cone length and average scale size and inversely correlated with relative sound seed yield (ratio of sound seed yield to cone length). It was shown that pollen source can affect seed yield. Thus pollen can also affect seed weight indirectly through its influence upon seed yield.
KEYW Cone properties, seed yield, pollination, seed weight.

550 AUTH Squillace, A. E., Bingham, R. T.
DATE 1954
TITL Breeding for improved growth rate and timber quality in western white pine.
PUBL Journal of Forestry. 52: 656-661.
ABST A cooperative project designed to breed blister-rust resistant and otherwise superior western white pine is now in its fifth year of activity. This report discusses phases involving intraspecies breeding for improved growth rate and timber quality. It describes the work being done and presents some early results. Growth rates of numerous progenies produced by controlled pollinations were statistically correlated with growth rates of their parents. Thus, experimental control was more complete than in many previous investigations on heritable vigor.
KEYW Height growth variation, phenotypic variation, branching habit, genotypic variation, disease resistance, racial variation.

551 AUTH Squillace, A. E., Bingham, R. T.
DATE 1954
TITL Forest genetics research in the Northern Rocky Mountain Region.
PUBL Journal of Forestry. 52: 691-692.
ABST The article summarizes all current forest genetics research in the Northern Rocky Mountain Region. Research concerning western white pine includes blister rust resistance, self-fertility, self-compatibility, and vegetative propagation techniques.
KEYW Disease resistance, inheritance, height growth, self fertility, self compatibility, vegetative propagation, hybridization, *Pinus strobus* x *P. monticola.*

552 AUTH Squillace, A. E., Bingham, R. T.
DATE 1958
TITL Localized ecotypic variation in western white pine.
PUBL Forest Science. 4: 20-34.
ABST Controlled breeding work with *Pinus monticola* conducted during the years 1950-55 has produced evidence that ecotypes of a very local nature exist. The evidence is based upon 166 controlled pollinations made among 45 trees (selected for apparent resistance to blister rust) growing in eight areas. In addition to the controlled pollinations, wind-pollinated seed were collected from the selections and from other nonresistant trees growing on the different areas. Certain selection areas, though in one case as little as one-half mile apart, represented considerably different environments. Growth rates of the parent trees and their progenies up to 4 years of age were measured. Seeds of 116 progenies were subjected to osmotic pressure tests, and foliage dry matter content was measured on 15 progenies. Results were as follows: (1) Progenies of trees from the better sites (moist, low elevations) grew more rapidly, on good planting sites, than those of trees from poorer sites (dry slopes or high elevations). (2) Progenies of trees from high elevations grew relatively more rapidly when outplanted at a high elevation than progenies of low elevation sources. (3) Progenies of trees from high elevations had more foliage dry matter content than those of low elevations. (4) Progeny seeds from different selection areas exhibited differences in apparent osmotic pressure. Where topography is highly variable and growing season moisture is a critical factor, selection pressures such as seedling establishment and growth rate discriminate against infiltration of genes from trees adapted to radically different although adjacent sites.
KEYW Ecotypic variation, osmotic pressure, foliage dry matter.

553 AUTH Squillace, A. E., Bingham, R. T.
DATE 1958
TITL Selective fertilization in *Pinus monticola* Dougl.
PUBL Silvae Genetica. 7: 188-196.
ABST Three tests were made specifically to determine whether any selective fertilization effects occurred when pollen of a given western white pine was in competition with that of another tree of the same species. In each test, matings were made between two trees, a and b, as follows: axa, axb, and ax(a+b). In the latter type of mating, pollens from the two parents (a+b) were mixed in equal proportions. Differences in early growth rate (length of epicotyl and total height) among the resulting 1-year-old progenies from matings within tests were used as the main basis for estimating the degree of selective fertilization. Other factors such as mean cotyledon number and seed yield had limited usefulness. In a moderately self-fertile tree crossing exceeded selfing. In a highly self-fertile tree, crossing exceeded selfing when its own pollen was mixed with that from one tree, while the reverse was true when its own pollen was mixed with that of another tree. Results of the tests, along with less reliable but more extensive determinations of the growth rate of wind-pollinated versus self- and cross-pollinated seedlings produced earlier, suggest that in stands under natural pollination conditions crossing largely exceeds selfing.
KEYW Selective fertilization, pollination.

554 AUTH Squillace, A. E., Bingham, R. T., Namkoong, G., Robinson, H. F.

DATE 1967
TITL Heritability of juvenile growth rate and expected gain from selection in western white pine.
PUBL Silvae Genetica. 16: 1-6.
ABST Materials consisted of sixty-one 4-year-old full-sib progenies produced from somewhat random matings among 21 parents. Progenies were grown at each of three localities in randomized blocks, using row-plots and three replications. Parental data consisted of average height growth during the last 10 years, adjusted for differences in age, and local site conditions. Progeny data used was fourth-year height increment. Narrow sense heritabilities, computed separately for each locality, averaged about 7 percent. For the combined analysis, they were only slightly less, indicating low environmental interaction in these data. Expected genetic gains were computed for several hypothetical breeding programs by using statistics obtained from the experimental interaction in these data. Results showed that appreciable genetic gains are possible in spite of the low heritability. Although other factors, not studied here, need to be considered in planning a breeding program, the results reported here suggest desirability of using a combination of phenotypic selection and progeny testing.
KEYW Heritability, juvenile growth rate, selection gain, height increment.

555 AUTH Stage, A. R.
DATE 1973
TITL Prognosis Model for stand development.
PUBL Research Paper INT-137. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 32 p.
ABST This paper describes a set of computer programs for combining quantitative silvicultural knowledge with past growth data from a sampled stand to make a prognosis of the course of development that the forest stand is expected to follow under alternative management prescriptions. An important design criterion of this procedure is that the Prognosis Model should apply to stands containing any mixture of species or age and size classes that grow as a community. The model simulates the deviation-amplifying aspect of the growth process by a unique procedure for introducing the stochastic elements in a deterministic computing algorithm. The growth rates predicted by the built-in models for diameter change are compared to the actual past growth of the sample trees to calibrate these models for the particular stand for which the prognosis is to be computed. Selection of trees to be cut at any period can utilize a variety of tree characters to emulate a wide range of silvicultural prescriptions.
KEYW Prognosis Model, growth rate, silvicultural prescriptions.

556 AUTH Steele, R., Arno, S. F., Pfister, R. D.
DATE 1976
TITL Preliminary forest habitat types of the Nezperce National Forest.
PUBL Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 71 p. [Mimeographed report.]
ABST The habitat types of the Nez Perce National Forest of north-central Idaho are described.
KEYW Habitat type.

557 AUTH Stein, W. I.
DATE 1964
TITL Seedspotting—revival of an old technique.
PUBL In: Western Reforestation Coordinating Committee annual meeting proceedings. p. 18-20.
ABST Discusses pros and cons of seed spotting as a replacement for broadcast seeding. Indicates that success with western white pine has been somewhat lower than sugar pine, the most successful species.
KEYW Seed spot, reforestation.

558 AUTH Steinhoff, R. J.
DATE 1972
TITL White pines of western North America and Central America.
PUBL In: Biology of rust resistance in forest trees. Miscellaneous Publication No. 1221. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 215-232.
ABST Six species of white pines (section *Strobus,* subgenus *strobus*) are native to western North America and Central America. All of these species are rather widely distributed with one or more species occurring in most of the major mountain ranges. Although any of the species may occur in pure stands, they usually are found mixed with several other coniferous species. Three of the species, *P. ayacahuite, P. lambertiana,* and *P. monticola*, are commercially important and a fourth, *P. strobiformis*, is harvested, but on a much smaller scale. Numerous efforts have been made throughout the world to cross these species with other white pines. Several of the resulting hybrid combinations show promise for a variety of uses and for planting in areas where there are few or no native white pines.
KEYW White pines, distribution, mixed stands, commercial importance.

559 AUTH Steinhoff, R. J.
DATE 1974
TITL Inheritance of cone color in *Pinus monticola.*
PUBL Heredity. 65: 60-61.
ABST Results indicate that the presence or absence of purple coloration in *Pinus monticola* cones is conditioned by a single gene having two alleles. Trees classified on the basis of several crosses as being homozygous or heterozygous for the allele promoting purple coloration had cones on which the amounts of purple and green varied; trees homozygous for the alternate allele had yellow-green cones on which there were no traces of purple.
KEYW Cone color.

560 AUTH Steinhoff, R. J.
DATE 1979
TITL Variation in early growth of western white pine in north Idaho.
PUBL Research Paper INT-222. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 22 p.
ABST In nursery and field tests representing five different studies, most of the variation in height growth or other traits in any one test area was among seedlings within family plots. Of the usable genetic variation in those traits, most (60-90 percent) was related to differences among the parent trees within stands. The remaining genetic variation was spread among geographic areas, elevational zones, or stands within these categories. When differences among the latter categories were significant, usually no pattern in the variation was apparent. Thus, although seedlings within families and family means within stands vary considerably, the lack of differences among stand means of those for broader geographic areas, and the absence of distinct variation patterns suggests that inland western white pine is fairly uniform. However, seedlings from high-elevation parents (generally 1,375 m or higher) were significantly shorter than those of low- and mid-elevation parents in some low- or mid-elevation tests. Even when elevational effects were not significant very few high-elevation families were among the tallest. Growth results to date indicate that only two seed zones are needed in northern Idaho—a low zone and a high zone generally separated at 1,375 m. Within the lower zone, trees with good growth potential can be found in nearly all stands.
KEYW Ecotypic variation, provenance test, geographical variation.

561 AUTH Steinhoff, R. J.
DATE 1981
TITL Survival and height growth of coastal and interior western white pine saplings in north Idaho.
PUBL Research Note INT-303. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST Western white pine saplings from the Olympic Peninsula of Washington and from northern Idaho sources planted together in northern Idaho did not differ in their survival rates. There has been no visual evidence of freezing injury to either group. At age 12, height of the coastal saplings generally falls within the height range for north Idaho saplings. The findings lend support to earlier results, which indicated that most of the variation in northern Idaho white pines is found within, rather than between, populations.
KEYW Geographic variation, provenance trials, height growth.

562 AUTH Steinhoff, R. J., Hoff, R. J.
DATE 1971
TITL Estimates of the heritability of height growth in western white pine based on parent-progeny relationships.
PUBL Silvae Genetica. 20: 141-143.
ABST Heritability estimates for periodic annual height growth were computed from regression and correlation coefficients of progeny growth on male parent, female parent, and mid-parent. The average for the various estimates increased by 1-1/2 times as the growth rate of the progenies approximately doubled. It appears that most of the increase in the estimates is due to the scaling effect of the increased growth rather than to shifts among the individual progenies. Actual growth increases calculated for a hypothetical selection and breeding program compared closely to predicted values.
KEYW Height growth, heritability.

563 AUTH Steinhoff, R. J., Hoff, R. J.
DATE 1972
TITL Chilling requirements for breaking dormancy of western white pine seedlings.
PUBL Research Note INT-153. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 6 p.
ABST One- and 2-year-old western white pine seedlings representative of five full-sib families were artificially chilled at 40 °F from 0 to 14 and from 8 to 20 weeks, respectively. After chilling, the seedlings were placed in a growth chamber and exposed to a 16-hour photoperiod and a 70 to 50 °F temperature

regime. Chilling for at least 14 weeks was necessary for seedlings to approach maximal shoot elongation.

KEYW Dormancy, chilling requirements.

564 AUTH Steinhoff, R. J., Joyce, D. G., Fins, L.
DATE 1983
TITL Isozyme variation in *Pinus monticola.*
PUBL Canadian Journal of Forest Research. 13(6): 1122-1132.
ABST Seeds from 28 stands representing most of the range of *Pinus monticola* were analyzed for electrophoretically demonstrable variation in 10 proteins encoded by 12 genetic loci. On the average, 65 percent of the loci per stand were polymorphic and expected heterozygosity of offspring was 18 percent. The populations could be assigned to two geographic groups, a broad northern one and a rather restricted southern one. The southern group consisted of populations from the Sierra Nevada and southern Cascade Mountains in northern California and from the Warner Mountains in south-central Oregon. Collections from stands in the central and southern Oregon Cascades and the Siskiyou Mountains of northwestern California were more nearly like the northern stands but exhibited some characteristics indicative of a transition area between the Sierra and northern types.
KEYW Isozymes, electrophoresis, geographic variation.

565 AUTH Stephan, B. R.
DATE 1974
TITL Geographic variation of *Pinus strobus* on the basis of first results of field trials in lower Saxony.
PUBL Silvae Genetica. 23(6): 214-220.
ABST *Pinus strobus* field trials in lower Saxony showed that height was negatively correlated with provenance latitude. One provenance of *P. monticola* and two provenances of *P. wallichiana* were compared with *P. strobus* and found to have only 85 percent and 40 percent of the average height, respectively.
KEYW Eastern white pine, differences between provenances, growth rate, mortality, blister rust infections, dwarf plants.

566 AUTH Stewart, M.
DATE 1966
TITL Cost study of partial cutting treatments in interior wet belt of British Columbia.
PUBL Research Note 32. Victoria, BC: British Columbia Forest Service. 22 p.
ABST A 95-year-old stand was subjected to seven cutting treatments to compare, on a commercial scale, a number of different selection principles when incorporated in a partial cut. The stand was composed of Douglas-fir (45-80 percent), western redcedar (20.0 percent), western larch (13.4 percent), western white pine (13.4 percent), Engelmann spruce (5.6 percent), and western hemlock (1.8 percent). It was concluded that the commonly used diameter limit combination of 16 inches d.b.h. for white pine, 12 inches for cedar, and 14 inches for other species does in fact give the logger maximum return for his money.
KEYW Partial cutting, cost study, poles, selection, mixed stand, logs.

567 AUTH Stout, A. W.
DATE 1960
TITL Storage-caused defects in Idaho white pine logs.
PUBL Research Note 2.112. Portland, OR: Western Pine Association. 4 p.
ABST Blue stain was found to be the major degrading factor in stored logs. Twenty percent of the lumber from one sampling of cold-decked logs carried stain, 6 percent being stained to the point of degrade that totaled $3.60/thousand bd ft loss. Checking and worm-hole damage increased the loss to $6.67/thousand bd ft. The bundled-in-water storage loss was negligible, but those logs entirely above water suffered stain losses amounting to $2.60/thousand bd ft.
KEYW Storage caused defects, blue stain, checking, worm-hole damage.

568 AUTH Stutz, R. E., Stout, A. W.
DATE 1957
TITL The nature of the chemical brown stains in lumber from the western pines.
PUBL Plant Physiology. 32: 13. Abstract.
ABST The chemical brown stain sometimes found in lumber from *Pinus ponderosa, P. lambertiana,* and *P. monticola* has previously been thought to be of a nonbiological origin. The authors demonstrated that the stain, which is restricted to the sapwood of old pond-stored logs, is caused by a microorganism that acts mainly on the ray cells. The presence of these bacteria is first indicated by the sour odor of the green lumber and the tanniclike pigment which may be found after kiln-drying. The brown color disappears in the advanced stages as the porosity and level of volatile acids increases.
KEYW Chemical brown stain, microorganism, sapwood, heartwood.

569 AUTH Sudworth, G. B.
DATE 1917
TITL Western white pine.

PUBL In: The pine trees of the Rocky Mountain Region. Bulletin 460. Washington, DC: U.S. Department of Agriculture. p. 4-6.

ABST Gives a general description of western white pine including early history, distinguishing characteristics, occurrence and habits, and longevity.

KEYW General description, longevity, history.

570 AUTH Sutherland, J. R.

DATE 1979

TITL The pathogenic fungus *Caloscypha fulgens* in stored conifer seeds in British Columbia and relation of its incidence to ground and squirrel-cache collected cones.

PUBL Canadian Journal of Forest Research 9(1): 129-132.

ABST Stored seeds were assayed for the seed-borne fungus *Caloscypha fulgens*. There was no relationship between incidence of infested seedlots and year of cone collection or geographic origin. Overall, squirrel cache-collected cones had the highest incidence, and slash-picked cones the lowest incidence, of *C. fulgens*-infested seedlots. The percentage of diseased seeds within infested seed lots was unrelated to the origin of ground-picked cones.

KEYW Conifer seeds, *Caloscypha fulgens*, pathogenic fungus, ground-collected cones, squirrel cache-collected cones.

571 AUTH Thyr, B. D.

DATE 1964

TITL Three fungi associated with foliage diseases of western pines.

PUBL Pullman, WA: Washington State University. 96 p. Ph.D. thesis.

ABST Three fungi (*Hypodermella arcuata, Lecanosticta* sp., and *Dothiatroma pini* var *linearis* var *nova*) associated with foliage diseases of western pines (*Pinus monticola, P. contorta,* and *P. ponderosa*) were investigated. Data from a needle cast bagging experiment indicate *Hypodermella arcuata* infects western white pine foliage mostly between mid-June and mid-July. Epiphytotics of needle cast are directly correlated with abundant rainfall during June and July of the preceding summer. Data from a needle blight bagging experiment indicate *Lecanosticta* infects western white pine foliage mostly during early June. Significance of needle blight is reduced to no more than a possible predisposing agent.

KEYW *Hypodermella arcuata, Dothistroma pini, Actinothyrium marginatum, Leptostroma decipieus, Lecanosticta acicola*, needle blight, needle cast, pine bark aphid.

572 AUTH Thyr, B. D., Shaw, C. G.

DATE 1966

TITL Ontogeny of the needle cast fungus, *Hypodermella arcuata*.

PUBL Mycologia. 58: 192-200.

ABST Hyphae of *Hypodermella arcuata* penetrate the endodermis of *Pinus monticola* and tissues external to it. Stromatic tissue developing between the host's hypodermis and epidermis constitutes the first macroscopic sign of the fungus and is visible on needles in April or May the year following infection. Differentiation begins in the upper half of the stoma with an orientation of hyphae perpendicular to the dermal tissues. These hyphae appear at maturity to be paraphyses, but initially are apically attached to the upper stromatic layer. Pseudoparenchymatous tissue surrounding the centrum becomes compressed forming a wall. Unitunicate asci develop from the basal pseudoparenchymatous tissue. The host's epidermis and the upper stromatic tissue of the fungus remain over the hymenium until maturity, at which time they split almost completely exposing the hymenium. Eight sheathed uninucleate ascospores develop in each ascus and are forcibly ejected when the mature ascocarp absorbs water. Ascospores germinate from either end by short germ tubes, form appressoria, and probably penetrate the needle directly through the cuticle and epidermis.

KEYW Ontogeny, needle cast, *Hypodermella arcuata.*

573 AUTH Timber of Canada.

DATE 1946

TITL Paint and wood work together.

PUBL Timber of Canada. 7(2): 54, 57, 59.

ABST Proper paint performance depends on surface material, correct construction, and paint quality. Factors affecting suitability of materials (wood surfaces) and paint are discussed.

KEYW Summer wood, spring wood, knots, lumber grade, paint failures, paintability.

574 AUTH Tinsley, S. L.

DATE 1938

TITL Direct seeding—a revival.

PUBL Journal of Forestry. 37: 888-890.

ABST Since the large-scale failure of direct seeding in the early days of forestry in the United States, artificial reforestation has been considered almost entirely in terms of planting. In this article, the author protests the abandonment of direct seeding while still in its infancy and presents the results of experiments conducted to determine the factors

affecting success and failure in direct seeding.
KEYW Artificial reforestation, direct seeding, seed spot method, stratification, rodent protection.

575 AUTH Townsend, A. M.
DATE 1969
TITL Physiological, morphological, and biochemical variation in western white pine (*Pinus monticola* Dougl.) seedlings from different altitudinal seed sources in Idaho.
PUBL East Lansing, MI: Michigan State University. 60 p. Ph.D. thesis.
ABST The western white pine seed sources studied represent a relatively homogeneous population; an overall lack of genetic differentiation in relation to seed source was observed in the physiological, morphological, and biochemical traits chosen for analysis. The terpene differences observed occurred only between widely separated areas and were unrelated to the elevation or latitude of the parent trees. Seed origin did not appear to be an important determinant of photosynthetic efficiency or CO_2 compensation point. At only one of the three light intensities examined was the seed source important in influencing photosynthetic efficiency. No differences among progeny were observed in the compensation point, at three light intensities and two temperatures. Height growth parameters were characterized by a similar homogeneity. There were no distinctions among sources in total height and only slight differences in the form of their growth curves.
KEYW Provenance study, monoterpenes, height growth, photosynthetic efficiency.

576 AUTH Townsend, A. M., Hanover, J. W.
DATE 1972
TITL Altitudinal variation in photosynthesis, growth, and monoterpene composition of western white pine (*Pinus monticola* Dougl.) seedlings.
PUBL Silvae Genetica. 21: 133-139.
ABST Seed from 24 parent trees were sown in altitudinal plots in the fall of 1965. The following seed characteristics were studied: (1) cortical oleoresin monoterpene composition, (2) photosynthesis and respiration, (3) total height and weekly growth throughout the growing season. The main conclusion drawn was that western white pine seed sources studied represented quite variable populations, but the variability appears to have only a slight association with environmental gradients.
KEYW Altitudinal variation, photosynthesis, seedling growth, monoterpenes, oleoresin.

577 AUTH Trappe, J. M.
DATE 1960
TITL Some probable mycorrhizal associations in the Pacific Northwest. II.
PUBL Northwest Science. 34: 113-117.
ABST The following mycorrhizal association is reported for western white pine: *Suillus granulatus,* on the west slope of the Cascade Range in Washington, elevation 2,000 ft.
KEYW Mycorrhiza, *Suillus granulatus.*

578 AUTH Troxell, H. E.
DATE 1954
TITL The use of Rocky Mountain species for pulping.
PUBL Journal of Forestry. 52(8): 583-586.
ABST Many tree species are quite acceptable for the manufacturing of paper and paper products although only small portions of the timber have been used for making pulp. As regional population and the national demand for paper products increase, the region will supply more of the Nation's future needs for pulpwood and paper and paper products by development of local manufacturing plants.
KEYW Utilization, pulpwood, economics.

579 AUTH Turner, J., Singer, M. J.
DATE 1976
TITL Nutrient distribution and cycling in a subalpine coniferous forest ecosystem.
PUBL Journal of Applied Ecology. 13: 295-301.
ABST The study was an attempt to characterize nutrient pools and the magnitude of nutrient transfers in a subalpine forest of old-growth Pacific silver fir (*Abies amabilis*). Standing biomass (44 percent of which were dead) consisted mainly of western white pine, indicating a recent change in species composition. Trees contributed by far the greatest amount of biomass and nutrients.
KEYW Nutrient distribution, nutrient cycling, biomass.

580 AUTH U.S. Department of Agriculture, Forest Service
DATE 1921
TITL Accelerated growth of western white pine after cutting.
PUBL Applied Forestry Note RS-D-1. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Borings were taken on 40 trees ranging in diameter at breast height from 3 to 14 inches. A very distinct acceleration in growth is noticeable as is a relation between height growth recovery and diameter recovery after cutting.

KEYW Cutting, height growth, diameter growth, recovery.

581 AUTH U.S. Department of Agriculture, Forest Service
DATE 1940
TITL Preliminary 1939 log prices in the Northern Rocky Mountain Region.
PUBL Research Note 7. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 2 p.
ABST Preliminary log prices for western white pine in 1939 are listed as total value of $558,838; average price per thousand bd ft of $17.90, and a price range of $10.00-21.75. Quantity was 31,218 thousand bd ft.
KEYW Log prices.

582 AUTH U.S. Department of Agriculture, Forest Service
DATE 1941
TITL Determining tree d.b.h. from stump measurements.
PUBL Research Note 16. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 6 p.
ABST Contains charts showing the relationship between stump size and tree diameter for five species including western white pine.
KEYW Stump size, tree diameter.

583 AUTH U.S. Department of Agriculture, Forest Service
DATE 1941
TITL Preliminary 1940 log prices in the Northern Rocky Mountain Region.
PUBL Research Note 15. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 2 p.
ABST Log prices for western white pine from all Districts averaged $18.05 per thousand bd ft; total value was $1,001,049 and total quantity was 55,465 thousand bd ft log scale.
KEYW Log prices.

584 AUTH U.S. Department of Agriculture, Forest Service
DATE 1949
TITL Pole blight—this is how to recognize it.
PUBL Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 6 p.
ABST A description of pole blight with photos.
KEYW Pole blight.

585 AUTH U.S. Department of Agriculture, Forest Service
DATE 1950
TITL Pathologists use planes to spot pole blight of pines.
PUBL Research Administration Press Release 289-50. Missoula, MT: U.S. Department of Agriculture, Forest Service. 1 p.
ABST Describes the use of planes for the scouting of pole blight areas.
KEYW Pole blight, aerial survey.

586 AUTH Vaartaja, O.
DATE 1960
TITL Photoperiodic response in seedlings of five species of *Betula* and *Pinus*.
PUBL Canadian Journal of Botany. 38: 807-813.
ABST The existence of photoperiodic response was experimentally established in *Betula lenta, B. mandshurica* var. *japonica, B. glandulosa, Pinus lambertiana*, and *P. monticola*. The responses of seedlings from different latitudes and altitudes were in accordance with the theory of photoperiodic ecotypes. Data indicate that the seedlings of *P. monticola* possess a marked photoperiodic response. If it was normal, the interaction of photoperiod and seed source would indicate the existence of photoperiodic ecotypes in *P. monticola*.
KEYW Photoperiod, ecotypes, seed source.

587 AUTH Vandersar, T. J. D.
DATE 1978
TITL Resistance of western white pine to feeding and oviposition by *Pissodes strobi* Peck in western Canada.
PUBL Journal of Chemical Ecology. 4(6): 641-647.
ABST Forced and choice feeding and oviposition experiments were conducted by caging overwintered *Pissodes strobi* on lateral branches or leaders of sympatric Engelmann spruce and/or western white pine trees. Results indicate that the releasing stimulus for feeding is present in the bark of both conifer species and suggest that a separate releasing stimulus for oviposition is absent from western white pine.
KEYW *Pissodes strobi*, weevil.

588 AUTH Vinje, M. G., Worster, H. E.
DATE 1970
TITL Hydrogen sulfide alkaline pulping. III. Effect of major process parameters and response of some North American softwood species.
PUBL Tappi. 53(6): 1082-1086.
ABST The major process parameters in the hydrogen sulfide kraft process are pressure, type

and quantity of alkaline "buffer," reuse of spent liquor, liquor-to-wood ratio, time, and temperature. The pulp yield increase is quite sensitive to small changes in hydrogen sulfide pressure over a certain pressure range. Pulp yield increases of approximately 6 percent based on wood were obtained by the application of (a) 0.5 percent calcium oxide in the form of calcium hydroxide or carbonate and (b) 1.4 percent sodium oxide in the form of sodium carbonate, kraft green liquor, or sodium hydroxide. Recycling spent pretreatment liquor tended to have a slightly beneficial effect on the yield increase. Liquor-to-wood ratios of 4.0/1 to 5.4/1 gave optimum results with both fresh and recycled liquors. Hydrogen sulfide-treated Douglas-fir, western redcedar, and western white pine chips, and a southern pine chip mixture required slightly less active alkali based on wood in kraft pulping than the corresponding untreated chips. Screened pulp yield increases of 5.3-6.6 percent on wood compared to the draft process were obtained with the wood species examined. The hydrogen sulfide kraft pulps were bleached to the same high brightness by the CEHDED sequence as the conventional kraft pulps and the yield increases were retained regardless of wood species.

KEYW Pulping, alkaline pulping, sulfate pulping, hydrogen sulfide, high-yield pulping, calcium compounds, sodium compounds, pressure, buffers, spent liquors, liquor-wood ratio, bleaching.

589 AUTH Vité, J. P., Rudinsky, J. A.
DATE 1959
TITL The water conducting systems in conifers and their importance to the distribution of trunk injected chemicals.
PUBL Contributions of the Boyce Thompson Institute. 20: 27-28.
ABST The routes by which water is conducted upward in conifers have been studied by injecting acid fuchsin near the base of young to middle-aged trees belonging to 23 species from 12 genera and four families. Five different patterns of translocation were detected in the sapwood of the conifers examined. Type A, the spiral ascent turning right, is characteristic of the investigated species of *Abies, Larix, Picea*, and subgenus *diploxylon* of the genus *Pinus*. The spiral runs from the outermost growth ring clockwise toward the center of the stem. Type B, the spiral ascent turning left, possessed by *Pinus monticola* and *P. lambertiana,* shows the same system as Type A, but in a reversed direction.
KEYW Water-conducting system, translocation.

590 AUTH Voldert, E.
DATE 1956
TITL Holzeigenschaften von gastbaumarten.
PUBL Holz Alsroh- und Werkstoff. 14: 81-86.
ABST Compares growth of several conifer species, including western white pine.
KEYW Growth rate.

591 AUTH Wahlenberg, W. G.
DATE 1924
TITL Circumventing delayed germination in the nursery.
PUBL Journal of Forestry. 22: 574-575.
ABST Delayed germination is common in western white pine. Fall sowing results in prompt and complete germination the following spring. This results in an even-aged stand and makes shading and mulching unnecessary.
KEYW Seed germination, nursery, delayed germination.

592 AUTH Wahlenberg, W. G.
DATE 1924
TITL Fall sowing and delayed germination of western white pine seed.
PUBL Agricultural Research. 28: 1127-1131.
ABST Experiments in northern Idaho and western Montana show that fall sowing of western white pine seed results in prompt and complete germination the following spring. Fall sowing eliminates the hold-over germination which follows spring sowing, thus assuring the production of a regular, even-aged seedling crop. The correct time for sowing within the fall season is very important. The findings in this report may not apply directly elsewhere, since climate and soil combine to make the sowing problem essentially local.
KEYW Seed dormancy, seed germination, percent germination sowing date, fall sowing.

593 AUTH Wahlenberg, W. G.
DATE 1924
TITL Overcoming delayed germination in the nursery.
PUBL Applied Forestry Note 53. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 2 p.
ABST Intensive experiments in fall sowing of western white pine seed were initiated to alleviate delayed germination. Final results showed that prompt and complete germination was secured the spring following fall sowing. In one case fall-sown plots had effected 83 percent of their total germination before the end of May, while less than 14 percent of the

germination of spring-sown plots had been effected at that time. Fall sowing of western white pine seed in the nursery is strongly advocated.

KEYW Fall sowing, spring sowing, delayed germination, nursery.

594 AUTH Wahlenberg, W. G.
DATE 1924
TITL The results of sowing in the Northern Rocky Mountain Region.
PUBL Applied Forestry Note 43. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Chronicles the failure of direct seeding by broadcast or corn planter in the Northern Rocky Mountains after the 1910 fires. Later attempts were made to sow all important species, including western white pine, by using seed spots. Survival was less than 15 percent for all species except Douglas-fir, which had not more than 20 percent survival. Failures are attributed to rodents, drought, cutworms, frost heaving, and mechanical obstacles.
KEYW Direct seeding, seed spots.

595 AUTH Wahlenberg, W. G.
DATE 1925
TITL Forestation research in Montana and north Idaho.
PUBL Journal of Forestry. 23: 589-599.
ABST A general discussion of current (1925) practices in District 1 of the Forest Service. The following information is given for western white pine: seedbed density was not to exceed 8,000 or 9,000 per 48-ft^2 bed. All white pine seed was being sown in early September. About 5/8 inch of sand or sand and soil was being used for seed cover. Roots were pruned to a depth of 4-5 inches. The cone method was the best planting method for western white pine.
KEYW Seedbed density, sowing time, root pruning.

596 AUTH Wahlenberg, W. G.
DATE 1925
TITL Reforestation by seed sowing in the Northern Rocky Mountains.
PUBL Agricultural Research. 30: 637-641.
ABST Of all the early direct-seeding projects in the Northern Rocky Mountain Region, only 6 percent were successful or partially successful. Later intensive experiments with seeding in prepared spots also failed to indicate practicable methods of direct seeding for this region. Speaking in terms of the percentage of spots with one or more survivors, about 20 percent survival was obtained with Douglas-fir under the best conditions, whereas other species were below 15 percent in survival in all cases. Western white and western yellow pine and Engelmann spruce, important commercial timber trees of the region, are essential in reforestation and are included in the group of species making an extremely poor showing in the experiments.
KEYW Reforestation, direct seeding.

597 AUTH Wahlenberg, W. G.
DATE 1926
TITL Age classes of western white pine planting stock in relation to aspect of planting site in northern Idaho.
PUBL Agricultural Research. 33: 611-619.
ABST In general the survival of planted western white pine trees places 2-2 transplanted stock at the top, with 1-2, 2-1, 2-0, and 1-1 following in descending order. Height growth also conforms to this order. The cost of survival definitely favors 2-0 seedlings on moderate sites, and 2-2 or 1-2 only on the more severe sites. Aspect of planting site is as important as the class of stock. Of the four exposures tested, the lowest survival accompanied by the fastest growth occurred on the west exposure. The east, northeast, and northwest aspects showed considerably higher survival in the order given.
KEYW Mortality season, planting stock, growth rate.

598 AUTH Wallis, G. W.
DATE 1976
TITL Growth characteristics of *Phellinus* (*Poria*) *weirii* in soil and on root and other surfaces.
PUBL Canadian Journal of Forest Research. 6(2): 229-232.
ABST Growth of *Phellinus* (*Poria*) *weirii* from alder block inoculum into the surrounding soil to infect healthy roots was less than 10 cm. Tree-to-tree spread of this root rot fungus, beyond that which would occur as a result of root contact, may be facilitated by growth of the mycelium over roots of minor vegetation and over wood buried in soil.
KEYW *Phellinus* (*Poria*) *weirii*, root inhabiting fungus, ectotrophic mycelial growth, bridging, root contact.

599 AUTH Walrath, F. J.
DATE 1927
TITL The better utilization of western white pine match stock.
PUBL Idaho Forester. 9: 19-20, 38.
ABST Identifies three ways to prevent blue stain: air seasoning, kiln drying, and treating with an antiseptic solution. Kiln drying at 140 °F for 6 hours was the only effective preventive treatment identified in a survey of 13 match

companies. Bleaching stained wood with chlorine may be feasible. Some companies are beginning to use blued material for match stock.

KEYW Match stock, utilization, blue stain, fungi, kiln drying.

600 AUTH Walsh, S. J.
DATE 1980
TITL Coniferous tree species mapping using Landsat data.
PUBL Remote Sensing of Environment. 9: 11-26.
ABST The identification and mapping of 12 surface-cover types within Crater Lake National Park, OR, including seven classes of coniferous tree species, has been accomplished through the use of Landsat digital data. The 12 surface-cover types were mapped with an average accuracy of 88.8 percent as compared with detailed ground truth.
KEYW Landsat, mapping cover types.

601 AUTH Walters, J.
DATE 1953
TITL Pitch moth infestation in western white pine.
PUBL Canadian Department of Agriculture, Science Service, Bi-monthly Progress Report. 9(1): 3-4.
ABST During November 1952, personnel of the Laboratory of Forest Biology, Vernon, visited a timber sale at Magna Bay, Shuswap Lake, to determine if insects were a factor in the unhealthy condition of western white pine (*Pinus monticola*) on the area. The inspections revealed that two species of pitch moths, tentatively identified as *Dioryctria zimmermani* and *Vespamima novaroensis*, were present in epidemic proportions. It was estimated that about 50 percent of the stand of white pine over 6 inches d.b.h. were infested in varying degrees. The infestation extended beyond the area of the timber sale (2,000 acres). In most cases the pitch moth attacks were associated with blister rust cankers. Apparently, the pitch moth population built up on diseased trees to its present status where it attacks healthy trees.
KEYW Pitch moth, *Dioryctria zimmermani, Vespamima novaroensis*, disease-insect relationships, blister rust.

602 AUTH Walters, J., Soos, J.
DATE 1962
TITL The vertical and horizontal organization of growth in some conifers of British Columbia.
PUBL Faculty Forest Research Paper 51. Vancouver, BC, Canada: University of British Columbia. 11 p.
ABST Studies were made to test the validity of earlier findings on Douglas-fir, western hemlock, western redcedar, western white pine, and Pacific silver fir. Thirty-nine trees ranging in age from 10 to 71 years and in height from 8 to 110 ft were analyzed. Trees were sectioned at the midpoint of each internode and the width of each annual ring was measured. Data from 19 trees are presented. The vertical and horizontal organization for the five species is described in terms of three sequences of ring width measurements. The sequences are shown to parallel those recognized earlier for red pine. Maximum mean cambial circumference and the most recent first order sequence of cambial circumference are shown to vary according to crown classification and site quality. The possible application of these relationships is discussed briefly with reference to site evaluation.
KEYW Vertical growth, horizontal growth, morphogenesis, ring width, growth organization.

603 AUTH Walters, J., Soos, J.
DATE 1963
TITL Shoot growth patterns of some British Columbia conifers.
PUBL Forest Science. 9: 73-85.
ABST The seasonal distribution of terminal and lateral shoot growth of *Pseudotsuga menziesii, Tsuga heterophylla, Thuja plicata*, and *Pinus monticola* was studied. Measurements were recorded weekly during the growing seasons of 1960 and 1961 on trees from 6 to 24 years old and from 2 to 22 ft high. Study areas were located at elevations of 550 and 1,500 feet. Results are presented graphically. The main conclusions are: (1) the phenology of shoot growth was not related to monthly precipitation or to mean monthly maximum and minimum temperatures, (2) the rate of growth and dates of annual commencement and termination of growth of individual trees were highly variable phenomena, (3) the general form of growth curves was similar from year to year indicating the influence of strong hereditary control, (4) the quantity of leader growth and length of growing period were not correlated, and (5) the relative rate of cumulative percentage growth of *Pinus monticola, Pseudotsuga menziesii, Tsuga heterophylla,* and *Thuja plicata* was in the order listed.
KEYW Shoot growth pattern, leader growth.

604 AUTH Warren, L. E.
DATE 1980
TITL Control of brush on conifer plantations with triclopyr ester.
PUBL In: Proceedings, Western Society of Weed Science. 35: 38-45.

ABST This report presents results of research to establish efficacious rates of triclopyr, carriers, and additives for effective brush control during the tolerant growth stages of conifers.
KEYW Brush control, herbicide treatments, triclopyr, conifer release, phenological stage.

605 AUTH Watson, C. W.
DATE 1925
TITL Young stands of western white pine progress report.
PUBL Idaho Forester. 7:21.
ABST Growth and yield of reproduction is sampled and a prediction is listed to 1984.
KEYW Reproduction, predicted yield.

606 AUTH Watson, C. W.
DATE 1927
TITL Partial cutting and stimulated growth in western white pine.
PUBL Idaho Forester. 9: 14-16, 42-44.
ABST Growth conditions for the white pine type were excellent in the region in which the Clearwater Timber Company was operating. An examination of their lands showed that a large part was covered with timber of the 80- to 100-year age class. Intensive studies covering four sections of this timber showed that the average acre contained a total volume of 37,603 bd ft, taking the trees down to 7 inches d.b.h. If a diameter limit of 11 inches is adopted for cutting, the volume removed would amount to 35,464 bd ft. Allowing for losses in logging the original stand, in a period of 35 years the residual material should produce a crop of about 8,212 bd ft, of which 75 percent would be white pine. To test these conclusions a series of eight 1-acre sample plots were laid out. These were logged, and periodic measurements on them were expected to solve the problem of growth in residual stands in this particular region.
KEYW Partial cutting, residual stands.

607 AUTH Watt, R. F.
DATE 1950
TITL Approach toward normal stocking in western white pine stands.
PUBL Northwest Science. 24: 149-157.
ABST The study is based upon growth records for 54 permanent yield plots established in 1925 and 1926 in northern Idaho while collecting data for second-growth western white pine yield tables. Tentative conclusions are: (1) understocked and overstocked stands tend to approach an average stocking near the values given in the second-growth western white pine yield tables for fully stocked stands. (2) The effect of age of stand on rate of approach to normal stocking appears to be slight. (3) The rate of change in mortality varies significantly with departure from near-normality density. (4) Individual plots showed much variation from average trends; therefore, it is unlikely that growth on small areas for short periods can be predicted with much precision. Predictions for larger areas and longer periods will be relatively reliable.
KEYW Normal stocking, natural reproduction, permanent yield plots, understocking, overstocking.

608 AUTH Watt, R. F.
DATE 1950
TITL Growth in understocked and overstocked western white pine stands.
PUBL Research Note 78. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The study showed that, over a period of time, understocked and overstocked western white pine stands tend to approach certain central values. However, these values are not exactly the values given in the western white pine yield tables (by Haig). For example, basal area stocking tends to approach 92 percent of the yield table volume. Scribner board-foot volume seems to be approaching 88 percent of normal volume and total cubic-foot volume 98 percent of normal. These percentages indicate that the white pine yield table values may be somewhat too high.
KEYW Growth stand density.

609 AUTH Watt, R. F.
DATE 1951
TITL Snow damage in a pole stand of western white pine.
PUBL Research Note 92. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Observations on a 2-acre permanent sample plot located in a severely damaged stand in Deception Creek Experimental Forest, ID, revealed the extent and nature of snow damage. The most important result of the winter's damage was a reduction of volume and growing stock on the area. On the study plot, 30 percent of the cubic volume, 37 percent of the trees, and 32 percent of the basal area were lost. Unusually heavy losses of the kind described are due to a combination of climatic conditions including wet snow, freezing temperatures, and wind.
KEYW Snow damage.

610 AUTH Watt, R. F.
DATE 1952
TITL Western white pine stands show irregular growth pattern.
PUBL Research Note 113. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 1 p.
ABST Twenty-five-year records of seven sample plots established in 1925 in the Oro Grande Creek drainage, Clearwater National Forest, illustrate irregular growth rates. The plots have a site index of 65, total 3.23 acres, and were 103 years old at the time of establishment. The stands grew an average of 490 bd ft per acre per year during the 25-year period, growing from 71,956 bd ft per acre to 84,200. Haig's yield tables would have forecast a growth of 667 bd ft per acre per year during the 25-year period.
KEYW Growth pattern stand.

611 AUTH Watt, R. F.
DATE 1953
TITL Site index changes in western white pine forests.
PUBL Research Note 132. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 2 p.
ABST Only small changes in site index have occurred on 88 permanent sample plots in the western white pine type. As shown by the magnitude of standard deviations, the plot data exhibited considerable variation. Some of this variation may have resulted from erratic changes in site index caused by methods of measurement used by the many different field parties over a period of 25 years. However, the changes in site index cannot be charged in very great part to errors in field work, nor can they be explained by recorded changes in soil and climate. Slight errors in the curves used for determining site index are the most logical explanation. In any event, the changes in site index are so small that site index values currently in use are sufficiently accurate for application to second-growth western white pine stands.
KEYW Site index.

612 AUTH Watt, R. F.
DATE 1954
TITL Mortality in second-growth stands of the western white pine type.
PUBL Research Note INT-9. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 5 p.
ABST A study of mortality records collected on 38 permanent sample plots showed mortality to be extremely variable. However, mortality increased with volume and age of the stand, and in the case of board-foot mortality, with site index. At 100 years of age, 10 percent of the total board-foot production, 22 percent of the cubic-foot volume, and 30 percent of the basal-area production had been lost through mortality. Wind and snow caused nearly half of this mortality; suppression, insects, and diseases were other important causes of death. One-fifth of the cubic-foot mortality was in trees less than 4.6 inches d.b.h., material considered to be unmerchantable. Two-thirds of the total board-foot mortality was in trees now of merchantable size, 10.6 inches d.b.h. and larger. However, because of the small volumes per acre available for salvage annually, much of the mortality probably will never have economic value. Natural mortality provides very crude but inexpensive thinning of second-growth stands.
KEYW Mortality, second-growth stands, gross production, wind, snow, insects, disease.

613 AUTH Watt, R. F.
DATE 1960
TITL Second-growth western white pine stands.
PUBL Technical Bulletin 1226. Washington, DC: U.S. Department of Agriculture, Forest Service. 60 p.
ABST Several analyses of data gathered on 94 permanent plots in second-growth western white pine stands from 20 to 100 years old were made. The plots were remeasured periodically to give information for 340 5-year growth periods. Repeated site index determinations were analyzed to see if site index changed with time, and, if so, what factors influenced the rate of change. It was determined that a statistically valid trend in site index occurred, but that the changes in site index were too small to have practical significance. Analysis of species composition changes showed that the composition of western white pine stands is established by the time the stands reach 30 years of age, and that changes in composition up to the age of 100 years are small. About half of the total mortality was attributed to wind and snow damage. Other important causes of mortality were insects, diseases, and suppression. Mortality caused the loss of 30 percent of the basal area, 22 percent of the cubic-foot volume, and 10 percent of the board-foot volume produced as the stands grew from age 30 to 100 years. The volume of mortality in a stand during a 5-year period was found to be correlated with the age and volume of the stands. Of these two variables, stand volume was the more important.

KEYW Second growth, mortality.

614 AUTH Weidman, R. H.
DATE 1922
TITL Intensive management on a demonstration forest.
PUBL Applied Forestry Note 35. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Gives background on establishment of Priest River Experimental Forest and stresses its use as a demonstration forest of intensive management of western white pine.
KEYW Intensive management, demonstration forest, Priest River Experimental Forest.

615 AUTH Weidman, R. H.
DATE 1924
TITL Preliminary results of the western white pine.
PUBL District 1 Applied Forestry Note 49. Missoula, MT: U.S. Department of Agriculture, Forest Service. 3 p.
ABST Contains a preliminary normal yield table for western white pine in Idaho, by age class on three types of sites. Curves of mean and current annual volume growth per acre based on plots in this study show that the greatest current growth in board feet is made at about 70 years and that the mean annual growth culminates at about 100 years.
KEYW Age class, mean annual growth, yield.

616 AUTH Weidman, R. H.
DATE 1927
TITL Prolific seed production in the forests of northern Idaho.
PUBL Northwest Science. 1: 79-80.
ABST In a moderately good seed year mature white pine stands produced 75,000 to 150,000 germinable seeds per acre. This study suggests that more prolific seedbearers such as cedar and hemlock would produce three or four times as much as white pine.
KEYW Seed production.

617 AUTH Weidman, R. H.
DATE 1933
TITL Progress of research in silviculture in the Inland Empire.
PUBL Northwest Science. 7: 67-71.
ABST Gives an overview of current progress of research in silviculture in the Inland Empire, including western white pine.
KEYW Silviculture.

618 AUTH Weir, J. R.
DATE 1923
TITL The effect of broadcast burning of sale areas on the growth of cull-producing fungi.
PUBL Journal of Forestry. 21: 183-184.
ABST Records brief results of observations in Idaho and Montana on the effect of clean burning on the production of sporophores of cull-producing fungi. The majority of cull fungi fruit with difficulty in the open exposed condition of a clean-cut area.
KEYW *Poria subacida, Polyporus schweinitzii, Fomes pini, Fomes annosus, Armillaria mellea,* cull fungi.

619 AUTH Weir, J. R., Hubert, H. H.
DATE 1919
TITL A study of the rots of western white pine.
PUBL Bulletin 799. Washington, DC: U.S. Department of Agriculture. 24 p.
ABST Within the area covered by British Columbia, Oregon, Washington, Idaho, and Montana, the three main wood-destroying fungi of western white pine (in order of importance) are *Trametes pini, Polyporus schweinitzii,* and *Fomes annosus.* Data show age as a prominent factor in determining the amount and stage of decay in a stand as well as the number of sporophore-bearing trees. Site also influences the rot in a stand. Proper pathological marking rules and practical methods for the disposal of infected slash are recommended as methods for control.
KEYW Volume losses, wood rot, *Trametes pini, Polyporus schweinitzii, Fomes annosus.*

620 AUTH Welch, D. S.
DATE 1947
TITL Study of the mortality of young western white pine trees.
PUBL Unpublished report, Special Research Project 11. Spokane, WA: U.S. Department of Agriculture, Bureau Plant of Industry, Office of Forest Pathology. 17 p. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID.
ABST The pole blight disease of *Pinus monticola* was studied in northern Idaho in 1947. Diseased trees were studied on the Coeur d'Alene, Kaniksu, and St. Joe National Forests. Intensive study of all the trees on a 0.1-acre sample plot, supplemented by field observation, served as a basis for a symptom description. The relation of age of trunk lesions to time of growth reduction was studied in the sample plot. In 13 of 19 cases, the trunk lesions antedated checking of growth of either terminals or wood rings. The possible causes of the disease are listed.
KEYW Pole blight.

621 AUTH Wellner, C. A.
DATE 1940
TITL Effects of cleaning in a reproduction stand of western white pine and associates.
PUBL Research Note 4. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Results on three cleaning plots established in 1935 in the upper west branch drainage of Priest River in the Kaniksu National Forest, ID, and remeasured in 1939, give a good example of the possibilities of this type of stand improvement in western white pine. These plots test the freeing of white pine reproduction from competing western larch and lodgepole pine. All tests to date speak well for this type of stand improvement work in the western white pine region. Cleanings are one of the cheapest stand improvement measures, and they appear to be one of the most effective.
KEYW Cleaning stand.

622 AUTH Wellner, C. A.
DATE 1940
TITL Relationships between three measures of stocking in natural reproduction of the western white pine type.
PUBL Journal of Forestry. 38: 636-638.
ABST The common use of more than one measure of stocking in natural reproduction stands has necessitated a means to convert one measure to another in order to compare stocking described in different terms. Three measures of stocking used in reproduction stands of the western white pine type are discussed in this article and a converting method is given, the principle of which is applicable elsewhere.
KEYW Natural reproduction, stocking, stocking measurements.

623 AUTH Wellner, C. A.
DATE 1941
TITL Blister rust control in relation to white pine silviculture.
PUBL Idaho Forester. 23: 13-15.
ABST Silviculture practices that aid in blister rust control must be considered. Blister rust control should not be considered for areas where white pine cannot be economically grown.
KEYW Silviculture in blister rust control.

624 AUTH Wellner, C. A.
DATE 1946
TITL Estimating light intensity in residual stands in advance of cutting.
PUBL Research Note 47. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Gives a "rule of thumb" method for estimating light intensity in mature stands of the western white pine type.
KEYW Light intensity, mature stands.

625 AUTH Wellner, C. A.
DATE 1946
TITL Improving composition in young western white pine stands.
PUBL Research Note 43. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 6 p.
ABST Stand composition and density in western white pine forests can be controlled most effectively, and with the least cost, by cleanings made during the juvenile stage of the stand. To be most effective, cleanings should be delayed until dominance is well established (stand age usually about 10 years), at which time the cleaning operation should be heavy. Not only trees of equal or greater height than white pine but also trees of lesser height, especially of the intolerant species, should be cut. A follow-up cleaning in 3 to 5 years after the first cleaning is desirable to maintain the lead of western white pine. Through cleanings effectively applied, a high proportion of western white pine can be maintained in future stands.
KEYW Cleaning stand, stand improvement.

626 AUTH Wellner, C. A.
DATE 1946
TITL Recent trends in silvicultural practice on National Forests in the western white pine type.
PUBL Journal of Forestry. 44: 942-944.
ABST Silvicultural practices in the western white pine type have been markedly affected by (1) truck logging; (2) greater utilization of species associated with western white pine; (3) the belief that losses from mountain pine beetle can be prevented by partial cuttings; (4) the use of silvicultural practices to aid control of blister rust; and (5) the increasing emphasis on getting all stands under management. Greatest changes are in mature stands.
KEYW Silviculture, truck logging, mountain pine beetle, species utilization.

627 AUTH Wellner, C. A.
DATE 1947
TITL Forest protection in the silviculture of western white pine forests.
PUBL Northwest Science. 21: 109-112.

ABST The author stated that only by a correlation and integration of protection, economics, and silvics can a sound practice of silviculture result. He then discussed various silvicultural methods to aid in control of forest insects, forest diseases, and fire. Cutting practices in immature, mature, and overmature stands to aid in forest protection were outlined.
KEYW Forest protection, silviculture, insect control, disease control, fire control, cutting practices, partial cutting.

628 AUTH Wellner, C. A.
DATE 1947
TITL Marking instructions for the white pine type in the Northern Rocky Mountain Region.
PUBL Unpublished report. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 14 p. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID.
ABST Discusses factors governing silvicultural practices and objectives in the white pine type, and then gives marking instructions for various stand conditions.
KEYW Timber marking, vigor classes, *Ribes* populations.

629 AUTH Wellner, C. A.
DATE 1947
TITL Pole blight: a new disease of western white pine.
PUBL Station Paper 8. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 5 p.
ABST Gives a summary of current knowledge on damage, extent, history, symptoms, impact, and needed research on pole blight.
KEYW Pole blight.

630 AUTH Wellner, C. A.
DATE 1948
TITL Light intensity related to stand density in mature stands of the western white pine type.
PUBL Journal of Forestry. 46: 16-19.
ABST Describes a method developed for estimating light intensity beneath the canopy in western white pine forests. Summation of diameters per acre is recommended as the most suitable measure of stand density to use in obtaining an estimate of light intensity. The relationship of light intensity to stand density is graphically illustrated, and tables show stand density equivalents for given light intensities beneath the canopy in mature stands of the western white pine type.
KEYW Light intensity, stand density, summation of diameters, canopy.

631 AUTH Wellner, C. A.
DATE 1948
TITL New disease threatens western white pine stands.
PUBL Journal of Forestry. 46: 294-295.
ABST Summarizes the extent of pole blight (70,000 acres) and describes the symptoms and history. Emphasizes the lack of knowledge concerning cause(s) for the disease and the need for intensive research concerning the problem.
KEYW Pole blight, pole blight acres.

632 AUTH Wellner, C. A.
DATE 1949
TITL Sale area betterment and stand improvement handbook for Northern Region.
PUBL Unpublished report. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 63 p. On file at: U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Moscow, ID.
ABST These instructions describe technical specifications and policies for performance of work with sale area betterment as provided for by the Knudson-Vandenberg Act and timber stand improvement operations from any source.
KEYW Stand improvement, silviculture methods, Knudson-Vandenberg Act, white pine type, ponderosa pine type, western larch-Douglas-fir type, lodgepole pine type, Engelmann spruce type, east-side Douglas-fir type.

633 AUTH Wellner, C. A.
DATE 1951
TITL Conservation influences of forest management.
PUBL In: Idaho conservation source book. Moscow, ID: University of Idaho. p. 93-98.
ABST There are many beneficial uses of forest lands. These uses are often complementary, but more often overlap or conflict. True application of conservation must achieve a balance between them. The author discusses the various uses.
KEYW Multiple use, conservation.

634 AUTH Wellner, C. A.
DATE 1952
TITL A vigor classification for mature western white pine trees in the Inland Empire.

PUBL Research Note 110. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The vigor classification for mature western white pine includes the following characteristics: crown class, crown density, live crown length in percent of total tree height, crown width, crown color, tip vigor, and dead branchlets or branches in upper crown.
KEYW Vigor classification, mature trees.

635 AUTH Wellner, C. A.
DATE 1959
TITL What research do we most need and how can we get it?
PUBL Western Forestry and Conservation Association, Proceedings. 1959: 45-49.
ABST A general talk presented at the 50th Western Forest Conference.
KEYW Research needs.

636 AUTH Wellner, C. A.
DATE 1962
TITL Silvics of western white pine.
PUBL Miscellaneous Publication 26. Washington, DC: U.S. Department of Agriculture, Forest Service. 24 p.
ABST Gives a detailed description of the silvics of western white pine.
KEYW Silvics, silviculture, habitat type, life history, racial variation, seeding habits, vegetative propagation, seed germination, seedling development, leaf litter nutrient content.

637 AUTH Wellner, C. A.
DATE 1964
TITL The impact of multiple use on silviculture in the Northern Rocky Mountain and Intermountain Regions.
PUBL Society of American Foresters, Proceedings. 1964: 20-22.
ABST It is not the impact of multiple use itself on silviculture that is of concern, but rather the effect of one use on another. Silviculture is simply the cultural means to accomplish the objectives of management once the use or uses of land have been determined.
KEYW Multiple use, silviculture.

638 AUTH Wellner, C. A.
DATE 1965
TITL Silvics of western white pine.
PUBL In: Silvics of forest trees of the United States. Agriculture Handbook 271. Washington, DC: U.S. Department of Agriculture, Forest Service. p. 477-478.
ABST A general description of the silvicultural characteristics of western white pine.
KEYW Habitat type, climate, range, soils, topography, life history, reproduction, early growth, saplings, dominant, codominant, mean annual increment, races, hybrids, maturity.

639 AUTH Wellner, C. A.
DATE 1967
TITL A silviculturist looks at the future of forest disease control.
PUBL Fifteenth Western International Forest Disease Work Conference Proceedings. 1967: 44-48.
ABST The author argues two major points: (1) Use what we know. (2) Develop imaginative new methods for recognition, inventory, evaluation, and control of forest diseases.
KEYW Forest disease control.

640 AUTH Wellner, C. A.
DATE 1969
TITL Progress in the development and maintenance of representative natural coniferous forest ecosystems in the Northern Rocky Mountains.
PUBL In: Coniferous forests of the Northern Rocky Mountains: Proceedings. Missoula, MT: University of Montana, Center for Natural Resources. p. 132-150.
ABST Discusses the need, opportunities and potential for natural areas throughout the Northern Rockies.
KEYW Natural areas, research natural areas, habitat types, cover types.

641 AUTH Wellner, C. A.
DATE 1970
TITL Fire history in the Northern Rocky Mountains.
PUBL Intermountain Fire Research Council Proceedings. 1970: 42-64.
ABST Historically, fires have repeatedly burned nearly every square foot of Northern Rocky Mountain forests. Relative fire resistance of conifers is listed including various characteristics of the species. Number of fires and acres burned from 1908 to 1969 are tabulated.
KEYW Fire history, commercial forests, fire resistance, fire damage by ecosystem, ecosystem acres.

642 AUTH Wellner, C. A.
DATE 1971
TITL The scientific basis for silvicultural practices in forests of the Northern Rocky Mountains.
PUBL Hearing Before the Subcommittee on Public Lands of the Senate, Ninety-Second Congress, First Session on Management Practices on the Public Lands, May 7 and

June 29, Part 3. Washington, DC: U.S. Government Printing Office. p. 929-930.

ABST Silvicultural practices for the regeneration and culture of Northern Rocky Mountain forests must be varied by cover types and by ecological variations within these types.

KEYW Congressional hearings, silvicultural practices.

643 AUTH Wellner, C. A.
DATE 1972
TITL Wildlife and wildlife habitat in ecosystem research.
PUBL Fifty-second annual conference of the Western Association of State Game Commissioners: Proceedings; Portland, OR. p. 452-465.
ABST Management of wildlands requires information about the resources and physical conditions of the land and relevant biological, economic, social, and political knowledge. Research and development by major ecosystems appear to be a promising way to acquire the needed information.
KEYW Cedar-hemlock ecosystem, wildlands, ecosystems research.

644 AUTH Wellner, C. A.
DATE 1976
TITL Frontiers of forestry research—Priest River Experimental Forest 1911-1976.
PUBL Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 148 p.
ABST The establishment, research, and people who have been involved with the Experimental Forest from 1911 to 1976 are included.
KEYW Priest River Experimental Forest.

645 AUTH Wellner, C. A.
DATE 1979
TITL Estimating light intensity beneath coniferous forest canopies: simple field method.
PUBL Research Note INT-250. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST Intensity of light under canopies of coniferous forest can be estimated easily without instruments but with accuracy adequate for numerous administrative and research studies.
KEYW Light intensity, estimations, coniferous forests, forest canopies.

646 AUTH Wellner, C. A., Boyd, R. J., Jr.
DATE 1959
TITL Partial cuttings in mature stands of the western white pine type.
PUBL Society of American Foresters, Proceedings. 1959: 27-32.
ABST Gross growth, mortality, net growth, and diameter growth were strongly associated with tree vigor. Partial cutting on a tree vigor basis has a real place in the management of mature and overmature western white pine stands.
KEYW Partial cuttings, vigor classification, old growth, mature stands.

647 AUTH Wellner, C. A., Foiles, M. W.
DATE 1951
TITL What to see and where to find it on the Deception Creek Experimental Forest.
PUBL Miscellaneous Publication 2. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 76 p.
ABST This booklet gives information on purposes, methods, and results of each of the main experiments located on this forest.
KEYW Deception Creek, mature timber, stand improvement, artificial regeneration, pole blight.

648 AUTH Wellner, C. A., Johnson, F. D.
DATE 1974
TITL Research natural area needs in Idaho, a first estimate.
PUBL Special Report. Moscow, ID: University of Idaho, College of Forestry, Wildlife, and Range Sciences. 179 p.
ABST A report of a workshop on research natural areas for Idaho. A list of needs, potential areas, and proposed areas. Includes discussions on rare and endangered animals and plants in Idaho.
KEYW Natural areas, research natural areas, disjunct plants, endangered animals, Idaho.

649 AUTH Wellner, C. A., Watt, R. F., Helmers, A. E.
DATE 1951
TITL What to see and where to find it on the Priest River Experimental Forest.
PUBL Miscellaneous Publication 3. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 86 p.
ABST Gives a summary of research on the forest. Some of the study plots were established as early as 1911.
KEYW Priest River Experimental Forest, fire research, weather tower, watershed research, silviculture, white pine regeneration, exotic trees, thinning studies, pruning studies, pole blight, blister rust.

650 AUTH Westfall, R. D.
DATE 1972

TITL Development and genetic variation in the cortical terpenes of species of *Pinus* and *Picea*.
PUBL Dissertation Abstracts International. 33B: 1877.
ABST Correlations among cortical monoterpenes in six forest tree species were compared for all species. Other comparisons including within-tree variation were made on some species (not including western white pine). For all species, positive correlations were found between alpha-pinene and camphene, and between 3-carene, gamma-terpinene, and terpinolene. Negative correlations were found between alpha-pinene and 3-carene, alpha-pinene and terpinolene, beta-pinene and 3-carene, and beta-pinene and terpinolene.
KEYW Developmental variation, genetic variation, cortical terpenes.

651 AUTH Wheaton, R. G.
DATE 1924
TITL The stimulation in growth of western white pine remaining on areas after logging.
PUBL Idaho Forester. 6: 37-39.
ABST Discusses stimulation of growth by tree diameter, the amount of release, and crown class.
KEYW Growth stimulation, thinning, rotation length.

652 AUTH Whitford, H. N.
DATE 1905
TITL The forests of the Flathead Valley, Montana. Contributions from the Hull Botanical Laboratory.
PUBL Botanical Gazette. 39: 99-122, 194-218, 276-296.
ABST The physiography, geology, climate, temperature, rainfall, wind, and sunshine of the region are described. Ecological units such as the meadow formation, spruce formation, western larch—Douglas-fir formation, and Douglas-fir—bull pine formation are described. The author also discusses the influence of fire on the forests of the region.
KEYW Ecological units, regional environmental factors, influence of fire.

653 AUTH Whitney, C. N.
DATE 1918
TITL A most remarkable story of pine lumber.
PUBL West Coast Lumberman. 33(395): 73-77.
ABST Describes the white pine resource, supply, annual cut, markets, uses, mechanical and physical properties, and manufacturing.
KEYW Timber volume marketing, utilization, mechanical properties, physical properties, manufacturing, annual cut.

654 AUTH Whitney, C. N.
DATE 1938
TITL Production of lumber and timber products in Idaho and Montana, 1937.
PUBL Applied Forestry Note 86. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 4 p.
ABST Western white pine lumber cut in 1937 was: Idaho, 459,531 thousand bd ft; Montana, 20,136 thousand bd ft; total 479,717 thousand bd ft, or 42.4 percent of total cut.
KEYW Lumber production, percent cut.

655 AUTH Whitney, C. N.
DATE 1939
TITL Production of lumber, lath, and shingles in Idaho and Montana, 1938.
PUBL Applied Forestry Note 91. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The following figures are given for Idaho white pine: lumber cut in 1928—Idaho, 286,754 thousand bd ft; Montana 21,139 thousand bd ft; total 307,893 thousand bd ft or 38.9, percent of the total. Percentage of white pine cut dropped from 50.8 percent in 1933 to 38.9 percent in 1938.
KEYW Lumber, production, percent cut.

656 AUTH Whitney, C. N.
DATE 1940
TITL Production of lumber and timber products in Idaho and Montana, 1939.
PUBL Research Note 8. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST The following statistics are given for western (Idaho) white pine: Idaho, 365,540 thousand bd ft; Montana, 29,989 thousand bd ft; total 395,529 thousand bd ft, or 41.8 percent of lumber cut in the Northern Rocky Mountains, in the year 1939.
KEYW Production.

657 AUTH Whitney, C. N.
DATE 1941
TITL Production of lumber, lath, and shingles in Idaho and Montana, 1940.
PUBL Research Note 14. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Statistics for western white pine are: lumber cut—Idaho, 421,698 thousand bd ft; Montana, 26,962 thousand bd ft; total 448,660 thousand bd ft, or 40.8 percent of total lumber cut in Northern Rocky Mountains.
KEYW Production lumber.

658 AUTH Wicker, E. F., Leaphart, C. D.
DATE 1961
TITL Effects of three antibiotics on tree diseases and forest vegetation following aerial application to western white pine stands.
PUBL Plant Disease Reporter. 45: 722-724.
ABST First-year observations indicated that the antifungal antibiotics cycloheximide (actidione) and phytoactin, as used, promoted control only on *Cronartium ribicola*. However, the semicarbazone derivative of cycloheximide appeared to effect some control of *Rhabdocline pseudotsugae*. Phytotoxic responses of forest vegetation other than western white pine were minor for all treatments.
KEYW Antibiotics, cycloheximide, acti-dione, phytoactin, *Rhabdocline pseudotsugae*, phytotoxic reaction.

659 AUTH Wikstrom, J. H.
DATE 1954
TITL 1952 log production for lumber and veneer.
PUBL Research Note 136. Missoula, MT: U.S. Department of Agriculture, Forest Service, Northern Rocky Mountain Forest and Range Experiment Station. 3 p.
ABST Total log receipts for western white pine in the Northern Rocky Mountain region during 1952 were: 268,491 thousand bd ft, or 13 percent of the total.
KEYW Production logs.

660 AUTH Wikstrom, J. H., Alley, J. R.
DATE 1968
TITL Ranking treatment opportunities in existing timber stands on white pine land in the Northern Region.
PUBL Research Paper INT-46. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 75 p.
ABST Economic evaluation of alternative ways of treating timber stands to increase timber production is a basic step toward efficient use of timber growing funds. The considerations in such an evaluation are discussed in relation to management of white pine land, and sample problems are presented. An EDP investment analysis program containing options usable in ranking stand replacement and timber stand improvement priorities is given, along with instructions for use.
KEYW Diameter growth, thinning, volume, site index, merchantable, cost estimate, value estimate, time period estimate.

661 AUTH Wikstrom, J. H., Wellner, C. A.
DATE 1961
TITL The opportunity to thin and prune in the Northern Rocky Mountain and Intermountain Regions.
PUBL Research Paper INT-61. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 14 p.
ABST If thinning is started early in the life of the stand, the ratio of cost to revenues will be the greatest. There should be some opportunity for profit in intermediate cuts. Thinning in overcrowded stands would return less.
KEYW Thinning, pruning, stand stagnation, harvest values.

662 AUTH Wilkinson, R. C.
DATE 1981
TITL White pine weevil attack susceptibility of western white pine in the Northeast.
PUBL Research Paper NE-483. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 3 p.
ABST Heights were measured and white-pine weevil attacks were recorded on 668 western white pines interplanted among 109 eastern white pines in a 10-year-old plantation in southern Maine. Less than 13 percent of the western white pines were successfully attacked (leader-killed) by the weevil.
KEYW Height growth, white-pine weevil.

663 AUTH Williams, C. B., Jr.
DATE 1966
TITL Snow damage to coniferous seedlings and saplings.
PUBL Research Note PNW-40. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 10 p.
ABST Western white pine received the following damage ratings in the spring of 1964: none, 18.2 percent; very light, 54.5 percent; light, 18.2 percent; moderate, 9.1 percent; severe, none.
KEYW Snow damage, saplings.

664 AUTH Williams, C. B., Jr.
DATE 1968
TITL Juvenile height growth of four upper-slope conifers in the Washington and northern Oregon Cascade Range.
PUBL Research Paper PNW-70. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 13 p.
ABST The following figures are given for 54 western white pine in this study: average age - 12.0 years, average years to reach breast height - 7.3 years, average internode, 1957-63 - 1.21 feet, average height - 10.4 feet, average d.b.h. - 1.7 inches.

KEYW Juvenile height growth, upper slope, Oregon Cascade Range, internode length, diameter breast height, breast height

665 AUTH Williamson, D. L., Schenk, J. A., Barr, W. F.
DATE 1966
TITL The biology of *Conophthorus monticolae* in northern Idaho.
PUBL Forest Science. 12: 234-240.
ABST Collections of *Pinus monticola* cones were made at 32 collection sites throughout northern Idaho. Longitudinal sections of the majority of these cones were examined and recorded as beetle infested or noninfested and the remaining cones placed in rearing. Life history data were obtained from infested cones collected periodically. *Conophthorus monticolae* was present in all stands sampled. Oviposition occurred from late May to late June, and eggs hatched in 5 to 10 days. Larvae passed through two instars in about 4 weeks and were most abundant from mid-June to mid-July. Pupation occurred within the cones, and transformation to the mature adult required 3 weeks. Overwintering took place in aborted cones. Larvae of *Dioryctria abietella* and *Eucosma rescissoriana* also were abundant. An average of 9 percent (0 to 36 percent) of the cones were infested by *C. monticolae,* and 26 percent (2 to 53 percent) by the cone moths. Seven parasite species also were recovered.
KEYW *Conophthorus monticolae*, cone insects, *Dioryctria abietella, Eucosma rescissoriana,* seasonal history.

666 AUTH Wilse, E.
DATE 1957
TITL Western white pine.
PUBL Skogeieren. 44: 418c.
ABST A description of western white pine.
KEYW Description.

667 AUTH Wilson, A. K.
DATE 1958
TITL Log production in Idaho and Montana, 1956.
PUBL Research Note 54. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 7 p.
ABST Figures for white pines (mostly western white, small amounts of whitebark or limber pine) are 267,443 thousand bd ft in northern Idaho, or 17.3 percent of the total for northern Idaho.
KEYW Log production.

668 AUTH Wilson, A. K.
DATE 1958
TITL Pulpwood production in Idaho and Montana, 1956.
PUBL Research Note 55. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 3 p.
ABST White pines are grouped with ponderosa pine in this tabulation. Together they made up 8.6 percent of the total pulpwood production in Montana and Idaho in 1956.
KEYW Pulpwood production.

669 AUTH Wilson, A. K.
DATE 1964
TITL Output of timber products in Idaho.
PUBL Research Paper INT-13. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 10 p.
ABST Western white pine accounted for 15 percent of the total timber products output in 1962. In northern Idaho the percentage of sawlogs was 20.8 (a total of 241,757 thousand bd ft).
KEYW Timber products, sawlog production, pulpwood production, pole production, veneer log production.

670 AUTH Wise, L. E., Rittenhouse, R. C.
DATE 1949
TITL The presence of arabinose units in pinewood and in kraft pulp.
PUBL Tappi. 32(9): 397-398.
ABST Arabinose, in small amounts, has been found in the hydrolyzates of the following pines: sugar pine, western white pine, and Virginia pine. Thus, it is impossible to differentiate between the "five-needle" and the "two-needle" pines on the basis of their arabinose content. Arabinose was found in the hydrolyzate of a commercial unbleached jack pine sulfate pulp. This presents evidence that, in at least one case, arabinose units are present in the cell walls of a coniferous wood.
KEYW Arabinose content, hydrolyzates, coniferous wood, cell walls, sulfate pulp.

671 AUTH Woo, J. Y.
DATE 1970
TITL Techniques for sectioning and staining tissue cultures of western white pine.
PUBL Research Note INT-116. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 4 p.
ABST Using transparent tape as a support, paraffin sections as thin as 5 mμ are microtomed from large, whole, and friable tissue cultures of western white pine and from pine cultures infected with blister rust fungus. Pathological differentiation is obtained with

Conant's quadruple stain or safranin 0-fast green stain, and cytological differentiation of the fungus is obtained with Heidenhain's hematoxylin stain or Flemming's triple stain.
KEYW Tissue culture, cytology.

672 AUTH Wood, K.
DATE 1959
TITL Canadian building timbers.
PUBL Wood. 24(8): 322-325.
ABST Major wood uses of the ten Canadian timber species are presented.
KEYW Building application.

673 AUTH Works, D. W., Boyd, R. J., Jr.
DATE 1972
TITL Using infrared irradiation to decrease germination time and to increase percent germination in various species of western conifer trees.
PUBL Transactions ASAE. 15(4): 760-762.
ABST Intense infrared irradiation of short duration promotes the germination of western white pine seed. The optimum exposure will vary from one seed lot to another; however, the variation is within narrow limits. An overexposure of irradiation will be destructive and cause devitalization. The degree of devitalization will increase as the exposure is increased.
KEYW Seed germination, infrared irradiation.

674 AUTH Wright, E., Graham, D. P.
DATE 1952
TITL Surveying for pole blight.
PUBL Journal of Forestry. 50: 680-682.
ABST The author concludes that observation and mapping of pole blight areas from the air, followed by inspection by ground crews, is the most complete and economical method of covering the region, including the most remote parts.
KEYW Pole blight, survey, mapping.

675 AUTH Wright, J. W.
DATE 1959
TITL Species hybridization in the white pines.
PUBL Forest Science. 5: 210-222.
ABST The results of 10 years of work on species hybridization with the five-needled pines at the Northeastern Forest Experiment Station are summarized. Including reciprocals, 38 different species combinations were attempted, of which 16 are regarded as successful or probably successful. Twelve of the 16 combinations have been authenticated in the nursery. Comparative trials were made of year-old pollen stored in a refrigerator or deep freeze and fresh pollen of the same species. In nearly all cases, total (filled plus empty) seed sets were similar for the two types of pollination; but sets of filled seeds were higher (appreciably so in three cases) after the use of fresh pollen than after the use of year-old pollen.
KEYW Hybrids.

676 AUTH Wright, J. W., Bingham, R. T., Dorman, K. W.
DATE 1958
TITL Genetic variation within geographic ecotypes of forest trees and its role in tree improvement.
PUBL Journal of Forestry. 56: 803-808.
ABST Summarizes known genetic variation within geographic ecotypes of forest trees. Cites work by Squillace and Bingham, which found statistically significant correlations between periodic annual increment of parents and height of progenies for western white pine.
KEYW Genetic variation, geographic ecotype, tree improvement, intraecotypic variation.

677 AUTH Wright, J. W., Gabriel, W. J.
DATE 1959
TITL Possibilities of breeding weevil-resistant white pine strains.
PUBL Research Paper NE-115. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 35 p.
ABST Western white pine shows the most immediate promise as a source of weevil resistance. It was studied in ten arboreta and forest plantings in New York and Pennsylvania. In all locations this species showed good climatic adaptability, growth rate, and bole form. It crosses easily with eastern white pine and is much less susceptible to blister rust. For the present it can be recommended for limited use in mixed plantings in areas subject to heavy weevil attack but with light *Ribes* populations.
KEYW Resistance weevil, white pine weevil, *Pissodes strobi*, provenance growth.

678 AUTH Young, V. A., Doll, G. B., Harris, G. A., Blaisdell, J. P.
DATE 1942
TITL The influence of sheep grazing on coniferous reproduction and forage on cut-over western white pine areas in northern Idaho.
PUBL University of Idaho Bulletin. 37(6): 46.
ABST Moderate grazing by sheep is beneficial to western white pine reproduction and has little effect on other coniferous species, but overgrazing is detrimental to the reproduction of all coniferous species, with white pine suffering least. The loss of coniferous seedlings due to sheep trampling was great-

est in the 1-year class and decreased as the seedlings matured to practically no loss at 5 years of age. In most cases, before direct coniferous seeding can be successfully practiced on badly overgrazed ranges, rodents must be controlled. Grazing may assist the reseeding of an area to white pine forest. Continuous overgrazing on most areas is not only harmful to coniferous reproduction, but the more palatable plants are replaced by less desirable ones. Certain browse species may produce two or more crops of leaves when grazed. Significant losses in wild black currant are caused by sheep grazing—especially overgrazing—but sticky currant is unaffected. Grazing does reduce fire hazard.

KEYW Grazing sheep, reseeding, ecological succession.

679 AUTH Zach, L. W., Bauer, D., Goodyear, H.
DATE 1943
TITL Practical application of plant hormones in forest-tree propagation.
PUBL Journal of Forestry. 41: 214.
ABST Seeds, cuttings, and 1- and 2-year-old seedlings of a variety of species were treated with indolebutyric acid to test the effectiveness of plant hormones in forest-tree propagation. Treatment results were mostly negative. Possible explanations were low March temperatures causing a reduction in hormone activity and a large amount of humus in the soil, which may have buffered the effect of the hormones.
KEYW Plant hormones, forest-tree propagation, indolebutyric acid, cuttings, seedlings, seeds, humus.

680 AUTH Zahner, R., Stage, A. R.
DATE 1966
TITL A procedure for calculating daily moisture stress and its utility in regressions of tree growth on weather.
PUBL Ecology. 47: 64-74.
ABST A method is described for computing daily values of moisture stress on forest vegetation, or water deficits, based on the differences between Thornthwaite's potential evapotranspiration and computed soil-moisture depletion. More realistic functions are used for soil-moisture depletion on specific soil types than have been customary. These functions relate daily rates of depletion to characteristics of soil-moisture tension. Separate functions account for surface soil wetting and drying processes following rain and dry periods. Two methods of summarizing the day-by-day distribution of moisture stress are illustrated. One utilizes directly accumulated stress values during such logical growth intervals as periods of leaf flushing or bud setting. The second method computes moisture stress and weather variables as functions of time over two growing seasons and utilizes the coefficients of orthogonal polynomials as independent variables in regressions of growth. In an example of western white pine basal area growth utilizing this latter method, moisture stress accounted for a 28 percent reduction in the variance of growth remaining after the effects of temperature and precipitation had been removed. The complete model accounted for 78 percent of the total variation.
KEYW Daily moisture stress, tree growth, weather, basal area.

681 AUTH Zavitkovski, J., Newton, I.
DATE 1969
TITL Effects of snowbrush on growth of some conifers.
PUBL Journal of Forestry. 67(4): 242-246.
ABST Findings indicate that snowbrush is more detrimental than beneficial in forest regeneration on west slopes of the Oregon Cascades.
KEYW *Ceanothus velutinus*, planted seedlings, natural regeneration, full occupancy suppression, competition, nitrogen fixing, nurse crop.

682 AUTH Zinkel, D. F., Spalding, B. P.
DATE 1972
TITL Anticopalic acid in *Pinus strobus* and *P. monticola.*
PUBL Phytochemistry. 2: 425-426.
ABST No anticopalic acid was found in the needles or cortex oleoresin of *Pinus monticola* from Lolo National Forest, MT. Anticopalic acid was previously reported as 55 percent of the resin acids in the wood of western white pine.
KEYW Anticopalic acid.

683 AUTH Zinkel, D. F., Toda, J. K., Rowe, J. W.
DATE 1971
TITL Occurrence of anticopalic acid in *Pinus monticola.*
PUBL Phytochemistry. 10: 1161-1163.
ABST Anticopalic acid, a labdane diterpene not previously reported in the gymnospermae, was found to be a major resin acid in the bark and in the wood of western white pine, *Pinus monticola.*
KEYW Anticopalic acid.

684 AUTH Zobel, D. B., Antos, J. A.
DATE 1982
TITL Adventitious rooting of eight conifers into a volcanic tephra deposit.

PUBL Canadian Journal of Forest Research. 12(3): 717-719.

ABST During the second growing season after the 1980 eruption of Mount St. Helens, *Abies amabilis, A. procera*, and *Pinus monticola* produced adventitious roots into tephra, the first known instance of rooting by these species. *Abies lasiocarpa, Chamaecyparis nootkatensis, Thuja plicata, Tsuga heterophylla*, and *T. mertensiana* also adventitiously rooted; *Pseudotsuga menziesii* did not.

KEYW Adventitious roots, tephra substrate.

AUTHOR INDEX

KEYWORD INDEX

☆U.S. GOVERNMENT PRINTING OFFICE: 1987-773-039/61032

Hoff, Ray J.; Qualls, Janet I.; Coffen, Dale O. 1987. Western white pine: an annotated bibliography. Gen. Tech. Rep. INT-232. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 138 p.

This bibliography lists 684 articles, limited mainly to English. It includes unpublished theses and typewritten reports. References concerning white pine blister rust have been excluded unless they provide other data or information. An author and subject index are included.

KEYWORDS: *Pinus monticola,* bibliography

INTERMOUNTAIN RESEARCH STATION

The Intermountain Research Station provides scientific knowledge and technology to improve management, protection, and use of the forests and rangelands of the Intermountain West. Research is designed to meet the needs of National Forest managers, Federal and State agencies, industry, academic institutions, public and private organizations, and individuals. Results of research are made available through publications, symposia, workshops, training sessions, and personal contacts.

The Intermountain Research Station territory includes Montana, Idaho, Utah, Nevada, and western Wyoming. Eighty-five percent of the lands in the Station area, about 231 million acres, are classified as forest or rangeland. They include grasslands, deserts, shrublands, alpine areas, and forests. They provide fiber for forest industries, minerals and fossil fuels for energy and industrial development, water for domestic and industrial consumption, forage for livestock and wildlife, and recreation opportunities for millions of visitors.

Several Station units conduct research in additional western States, or have missions that are national or international in scope.

Station laboratories are located in:

Boise, Idaho

Bozeman, Montana (in cooperation with Montana State University)

Logan, Utah (in cooperation with Utah State University)

Missoula, Montana (in cooperation with the University of Montana)

Moscow, Idaho (in cooperation with the University of Idaho)

Ogden, Utah

Provo, Utah (in cooperation with Brigham Young University)

Reno, Nevada (in cooperation with the University of Nevada)